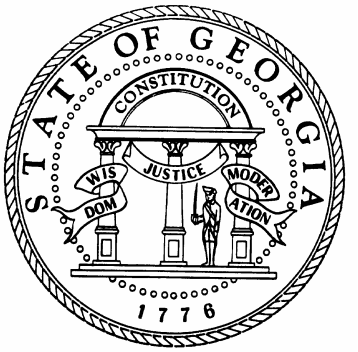
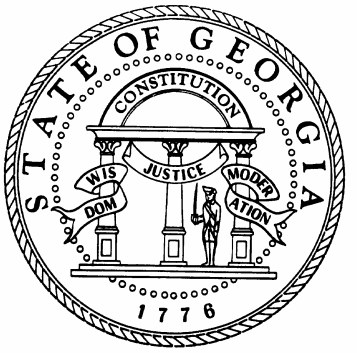
State of Georgia Telecommunications Design Manual



Georgia State Financing and Investment Commission

March 1, 2003

State of Georgia
Telecommunications Design Manual



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PREFACE

Publication Designation

State of Georgia Telecommunications Design Manual

Subject

Networking, Telecommunications, and Cabling

Effective Date

March 1, 2003

Supersedes

State of Georgia Telecommunications Design Manual, July 1, 2002
Telecommunications AEC Design Manual, September, 2001

Scheduled Review

Six months from effective date

Authority

Statewide Technical Committee

Overview

This is the first major revision of the Telecommunications Design Manual. The intent of this document is to provide guidance to professionals engaged in design projects for the State of Georgia all of which usually include a telecommunications component. Nonetheless, the design of a telecommunications system requires the use of a Registered Communications Distribution Designer who will retain full responsibility for the design of the telecommunications distribution system

This document addresses the technical aspects of telecommunications systems deployment. Administrative procedures are a separate document.

Significant changes in technology and standards have occurred since the 2002 publication. Those changes have been incorporated into this revision. One major revision is the addition of Category 6 cabling which is the result of ratification of the standard for Category 6 cabling by ANSI/ANSI/TIA/EIA in 2002

This document is not intended for use as a template.

Stakeholders external to the Georgia Technology Authority (other state agencies) and external to the State of Georgia have reviewed this revision. Documents prepared by other agencies (Board of Regents, Georgia Building Authority, etc.) have been reviewed and are addressed as part of this document. This helps the relevancy of the document and adds significantly to the technological merit of this document.

ACKNOWLEDGEMENTS

The Georgia Technology Authority, the Georgia State Financing and Investment Commission, the Governor's Office of Planning and Budget and the editors of this document wish to thank our industry partners and those state employees who donated their time and effort to the development and production of this document.

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CONTENTS

GENERAL

A. GENERAL RECOMMENDATIONS

1.0 Introduction

This manual is written to provide guidance to State of Georgia Agencies, Architects and Design Engineers involved with the design and construction of State facilities. The Georgia Technology Authority (GTA), the Georgia State Financing and Investment Commission (GSFIC) and the Governor's Office of Planning and Budget (OPB) along with representatives from all many other state agencies developed have participated in the development of this manual. This manual is based upon the most current available literature; codes, standards and industry accepted practice available at the time of publication. This is a living document and the result of many statewide technical committee meetings. This committee consists of state agency officials and industry partners tasked with producing and continuously maintaining this manual.

This design manual establishes a strategic direction for the physical connection of communications devices in State of Georgia facilities. Architects, Engineers and State Agency officials should are encouraged to use this manual as a design reference for telecommunications. A properly designed and constructed telecommunications system should be adaptable to change over the life of the building. The criteria contained within this manual are subject to revisions and updates due to technological advances within the telecommunications industry.

Telecommunications has a financial impact on all construction and renovation of State of Georgia buildings. It is expensive and time-consuming to continually change cabling systems to support different network configurations, computer systems and the relocation of employees. Therefore, it is very important that the design and construction of new or renovated buildings effectively avoids obsolescence. That is why in recent years, national and international standards organizations have been developing standards for the various elements of telecommunications cabling systems. The State of Georgia's implementation of these standards will ensure a flexible, uniform telecommunications environment and:

- Provide telecommunications architecture based on recognized standards to support efficient, long-lasting, cost-effective operations.
- Reduce the amount of time required to install new networks or to reconfigure existing local area networks.
- Provide the flexibility to operate multiple high bandwidth technologies on a single structured cabling system.
- Eliminate the cost of installing non-standard, proprietary, vendor-specific cabling by providing standards-based cabling systems that will support a wide variety of equipment.
- Improve network manageability and facilitate automated cabling system management through the use of uniform and industry standard identification and numbering schemes.
- Allow for the growth of anticipated high speed, high bandwidth Local Area Networks (LANs), Metropolitan Area Networks (MANs) and Wide Area Networks (WANs) that may be required by future specialized applications.

2.0 Background

Earlier State of Georgia telecommunications manuals focused on building cabling only and were incomplete. As development progressed on these earlier manuals technology advanced and necessitated continuous revisions of those documents. The last telecommunications manual was published in 2001. This manual replaces all previously published GTA guidelines, directives with respect to major construction and renovation projects. Guidelines published by many other Agencies have been reviewed and included in this manual. This manual addresses expanded recommendations for telecommunications and includes OSP Distribution. These expanded recommendations emanated from the work of the Georgia Statewide Telecommunications Technical Committee. This

committee consists of state agency professionals, local government agency officials, manufacturers, vendors, Architects, Professional Engineers, higher education representatives and other design professionals with extensive experience in the telecommunications field.

3.0 Design Manual Scope

This manual is applicable to all state agencies and institutions of higher education (hereinafter collectively referred to as "Agencies") responsible for local and wide-area networking, telecommunications, or related cabling between or within state-owned or state-leased buildings. This manual is intended to provide telecommunications design and installation information for all new state buildings and major renovations. This manual should also be used for cable retrofitting or telecommunications re-cabling unless there is a strong business case for not doing so.

Specifically this manual pertains to cabling in:

- Newly constructed buildings
- Buildings undergoing major renovations
- New long-term leased occupancy spaces
- New multi-building sites that use state owned fiber optic or copper cables

4.0 Purpose of This Manual

Effective telecommunications and networking cannot be accomplished without adherence to standards. Additionally cabling infrastructure costs cannot be contained without adherence to sound installation and management practices. To ensure that the future telecommunications and connectivity needs of agencies are met in a cost-effective manner, this manual confirms the State of Georgia's support for ANSI/ANSI/TIA/EIA and IEEE standards for telecommunications.

The following standards are applicable to telecommunications cabling:

- The American National Standards Institute (ANSI) approves standards as having been properly developed.
- The Telecommunications Industry Association (TIA) develops standards for cables.
- The Electronics Industry Association (EIA) focuses on physical device standards.
- The Institute of Electrical and Electronics Engineers (IEEE) publishes networking and telecommunications standards

This manual is intended to give recommended minimums for telecommunications in state facilities. This manual addresses the physical pathways, media, and cable administration practices. The purpose of this manual is threefold:

- To provide direction
- To enable the planning of telecommunications facilities with little knowledge of the specific electronic equipment that will be installed
- To define a generic telecommunications cabling system that will support state agency cabling needs in a multi-vendor and multi-product environment.

5.0 The Statewide Technical Committee Approach

This manual provides: 1) a listing of the general telecommunications, networking, cabling and administration recommendations adopted by the State of Georgia; 2) reference materials and web sites related to the recommendations; and 3) a general discussion of how state agencies should typically address the recommendations.

ANSI/ANSI/TIA/EIA and IEEE standards referenced herein are adopted in both their present state and as amended or replaced unless otherwise indicated in the statement of GTA recommendations provided below. Every effort will be made to ensure that these recommendations are reviewed semi-annually. Whenever ANSI/ANSI/TIA/EIA or IEEE introduces major modifications, this will trigger a committee review of recommendations by the Statewide Telecommunications Technical Committee. As reviews are conducted, the review dates and recommended modifications will be added to this manual.

The committee recommends following the general cabling industry practice of using a Structured Cabling System (**SCS**). Other cabling systems may be installed in addition to the SCS but **as a minimum** the committee recommends that a SCS be installed. A properly designed SCS allows the designer and installer to cable a building for telecommunications needs without knowing specifically what equipment will be utilized. The SCS is geared for long-term stability and flexibility and is based on the idea of wiring buildings once. The SCS approach allows the cable and telecommunications outlets to remain unchanged as connections and services vary.

There are typically eight major components of the SCS as follows: 1**) Service Entrance Facilities** 2) **Main Equipment Room** 3) **Telecommunications Room** 4) **Backbone Cabling** 5) **Horizontal Cabling** and 6) **Work Area Outlets** 7) **Grounding and Bonding** and 8) **Administration and Labeling**.

Due to the legacy placement of cabling on many College and University campuses, in some instances it may be necessary to deviate from the SCS scheme and continue with the current scheme. OSP pathways and Backbone Cabling that will be customer owned should be considered part of the SCS.

To become a member of the Statewide Telecommunications Technical Committee contact your regional Georgia Technology Authority/ Communications Distribution Designer (GTA/RCDD) or the Georgia State Financing and Investment Commission (GSFIC).

6.0 Telecommunications Design Intent

It is desired by the State of Georgia to have a uniform cabling plan in each building/facility for voice, data, image, and video distribution to allow for flexible changes, office renovations, equipment migrations and constant upgrades. This cabling system should be based on industry standard structured cabling systems that are not proprietary and conform to current ANSI/ANSI/TIA/EIA Commercial Cabling Standards.

It is the intent of this manual to provide guidance to designers and engineers to assure adherence to nationally recognized codes and standards. For those involved in designing telecommunications infrastructure and cabling systems for State of Georgia buildings the GTA/RCDD provides expert design review assistance to the Agency and other design professionals.

7.0 Committee Objectives

The Statewide Telecommunications Technical Committee's objectives are as follows:

- To explain the interplay of industry-supported standards, Georgia laws and sound enterprise business practices in providing an architectural foundation for telecommunications and networking for Georgia's agencies.

- To provide the agency with recommendations related to networking and telecommunications infrastructure development, maintenance and administration.

- To provide a framework for the integration of telecommunications into the design and installation of state facilities.

8.0 Telecommunications Budget

The telecommunications budget for a project should include the costs associated with engineering, installation, testing and documentation. The engineering cost should include, design, engineering, supervisory and project management functions. The installation cost should include the actual installation labor and materials costs for a Structured Cabling System. Testing and documentation costs should include the associated electronic test report documentation, electronic and hard copies of all as-built drawings and the software used to read/view the electronic testing and as-built drawings.

The overall budget should include all of the above for the following items:

- The inter-building cabling and support infrastructure for voice, data and video
- The intra-building cabling and support infrastructure for voice, data and video
- All devices for CATV connections
- All interconnect and patch cables.

At this time, active and passive devices for all data network connections (i.e. switches, routers, fiber optic devices, etc…) are should not be included in the construction phase. Electronic network equipment should be provided by the agency.

9.0 Regulatory Recommendations / Codes and Standards

9.1 Regulatory Agencies

Currently, the following agencies and their codes, standards and regulations should govern all telecommunications work performed for the State of Georgia.

Acronym	Organization	Web Site
ANSI	American National Standards Institute	www.ansi.org
ASTM	American Society for Testing Materials	www.astm.org
BICSI	Building Industry Consulting Service International	www.bicsi.org
BOCA	Building Officials and Code Administrators International, Inc.	www.bocai.org
EIA	Electronic Industries Alliance	www.eia.org
EPA	Environmental Protection Agency	www.epa.gov
EPD - Georgia	Georgia Environmental Protection Division	www.dnr.state.ga.us/dnr/environ
FCC	Federal Communications Commission	www.fcc.org
ICEA	Insulated Cable Engineers Association, Inc.	www.icea.net
IEEE	Institute of Electrical and Electronic Engineers, Inc	www.ieee.org
IEC	International Electrotechnical Commission	www.iec.ch
ISO	International Organization for Standardization	www.iso.ch
NEMA	National Electrical Manufacturers Association	www.nema.org
NFPA	National Fire Protection Association	www.nfpa.org
NEC (NFPA 70)	National Electrical Code	www.nfpa.org
OSHA	Occupational Safety and Hazard Administration	www.osha.gov
SCTE	Society of Cable Telecommunications Engineers	www.scte.org
RUS	Rural Utilities Services	www.rurdev.usda.gov/rus/

TIA	Telecommunications Industry Association	www.tiaonline.org
UL	Underwriters Laboratories	www.ul.com

9.2 National Electrical Code, NFPA 70

The National Fire Protection Association has acted as the sponsor of the National Electrical Code (NEC) since 1911. The original Code was developed in 1897 as a result of the united efforts of various insurance, electrical, architectural, and allied interests. The purpose of the NEC is the practical safeguarding of persons and property from hazards arising from the use of electricity. The NEC provides the minimum code requirements for electrical safety. In telecommunications distribution design, the NEC must be used in concert with the ANSI/EIA/TIA standards identified below, which are intended to insure the performance of the telecommunications infrastructure. Designers should always consult with the local electrical Authority Having Jurisdiction (electrical inspector), who may have additional, more stringent requirements, beyond those contained in the NEC.

The particular sections of the NEC of interest to designers and installers of telecommunications distribution, telecommunications systems, and information processing systems are:

Article 250 -- Grounding
Article 517 -- Health Care Facilities
Article 645 -- Information Technology Equipment
Article 770 -- Optical Fiber Cables and Raceways
Chapter 8 -- Communications Systems

The National Electrical Code is available from:

National Fire Protection Association
1 Batterymarch Park
PO Box 9101
Quincy, MA 02269-9904

9.3 ANSI/ANSI/TIA/EIA Standards

The Telecommunications Industry Association/Electronics Industry Association (ANSI/TIA/EIA) engineering standards and publications are designed to serve the public interest by eliminating misunderstandings between manufacturers and purchasers. The standards facilitate interchangeability and improvement of products, and assist the purchaser in selecting and obtaining the proper product for his particular need.

ANSI/TIA/EIA Standards are updated every 5 years. Due to the rapid changes in the telecommunications and electronics industries, ANSI/TIA/EIA publishes periodic Telecommunications Systems Bulletins (TSB) which provides additional guidance on certain technical issues that must be addressed prior to the next scheduled revision of the Standards. The information contained in TSBs is usually incorporated into the applicable Standard during the next Standard revision. Standards and publications are adopted by ANSI/TIA/EIA in accordance with American National Standards Institute (ANSI) patent policy.

ANSI/ANSI/TIA/EIA Standards are available from:

Global Engineering Documents
15 Inverness Way East
Englewood, CO 80112-5704
1-800-624-3974

Optical Fiber Systems Test Procedures, ANSI/ANSI/TIA/EIA-526 (series)

ANSI/ANSI/TIA/EIA-526 contains a series of test procedures developed to provide uniform procedures for testing all or part of fiber optic systems or subsystems intended for optical communications or data transmission use. The base document is ANSI/ANSI/TIA/EIA-526 and each test procedure is listed separately by test procedure number for both multimode and single mode fiber optic cable.

Cabling Standard, ANSI/ANSI/TIA/EIA-568 (series)

The ANSI/ANSI/TIA/EIA-568 (series) is the Commercial Building Telecommunications Cabling Standard. This standard defines a generic telecommunications wiring system for commercial buildings that will support a multi-product, multi-vendor environment. It also provides direction for the design of telecommunications products for commercial enterprise.

The purpose of the standard is to enable planning and installation of building wiring with little knowledge of the telecommunications products that subsequently will be installed. Installation of wiring systems during building construction or renovation is significantly less expensive and less disruptive than after the building is occupied. ANSI/TIA/EIA-568 establishes performance and technical criteria for various wiring system configurations for interfacing and connecting their respective elements.

Pathways and Spaces, ANSI/EIA/TIA-569 (series)

The ANSI/EIA/TIA-569 (series) is the Commercial Building Standard for Telecommunications Pathways and Spaces. This standard recognizes three fundamental concepts related to telecommunications and buildings

(1) Buildings are dynamic.

Over the life of a building, or campus, remodeling is more the rule than the exception. The standard recognizes that changes will take place.

(2) Building telecommunications systems and media are dynamic.

Over the life of a building, or campus, both telecommunications equipment and cabling requirements change dramatically. The standard recognizes this fact by being as independent as possible from specific vendor equipment and media.

(3) Telecommunications is more than just voice and data.

Telecommunications also encompasses many other building systems including environmental controls, security, audio, television, sensing, alarms and paging.

Telecommunications includes all low voltage signal systems that convey information within or between buildings. In order to have a building, or campus, successfully designed, constructed, and provisioned for telecommunications, it is imperative that the telecommunications design be incorporated during the preliminary architectural design phase. To accomplish this, the architect must work closely with the designated GTA/RCDD; and the Agency's Facilities Coordinator., and the Architect

Administration Standard, ANSI/ANSI/TIA/EIA-606A (series)

The ANSI/ANSI/TIA/EIA-606A (series) is the Administration Standard for the Telecommunications Infrastructure of Commercial Buildings. Administration of the telecommunications infrastructure includes documentation of cables, termination hardware, patching and cross-connection facilities, conduits, other cable pathways, telecommunications rooms, and other telecommunications spaces. The purpose of this standard is to provide a uniform administration scheme that is independent of applications, which may change several times throughout the life of a building. This standard establishes guidelines for owners, end users, manufacturers, installers, and facilities administrators involved

in the administration of the telecommunications infrastructure.

Grounding and Bonding, ANSI/ANSI/TIA/EIA-607 (series)

The ANSI/ANSI/TIA/EIA-606 (series) is the Commercial Building Grounding and Bonding Requirements for Telecommunications. The National Electrical Code (NEC) provides grounding, bonding, and electrical protection requirements to ensure life safety. Modern telecommunications systems require an effective grounding infrastructure to insure optimum performance of the wide variety of electronic information transport systems that may be used throughout the life of a building. The grounding and bonding requirements of this standard are additional technical requirements for telecommunications that are beyond the scope of the NEC. These standards are intended to work in concert with the cabling topology specified in ANSI/ANSI/TIA/EIA-568, and installed in the pathways and spaces designed in accordance with ANSI/ANSI/TIA/EIA-569.

9.4 Local Area Network Ethernet Standard, IEEE 802.3 (series)

The State of Georgia typically utilizes the Ethernet LAN protocol at all facilities. All State of Georgia telecommunications infrastructure must be designed to support the Institute of Electrical and Electronic Engineers (IEEE) Ethernet 802.3 standards. Most State organizations are in the process of migrating to the 1000Base-X Gigabit Ethernet protocol based on the IEEE 802.3z standard. All newly installed cabling should support this protocol. Careful consideration must be given to the multimode fiber optic distance limitations and signal loss limitations (less than 2.5 dB end-to-end) necessary to support the IEEE 802.3z protocol.

9.5 The BICSI Telecommunications Distribution Methods Manual

The Building Industry Consulting Service International, Inc. (BICSI) is a Telecommunications Association whose mission is to provide state-of-the-art telecommunications knowledge to the industry, resulting in good service to the end user. BICSI develops and publishes the Telecommunications Distribution Methods Manual (TDMM). The TDMM is not a code or standard. The TDMM is an extensive volume of information on the various aspects of telecommunications systems and telecommunications distribution. The TDMM provides discussions and examples of various engineering methods and design solutions that can be selected and employed in order to meet the requirements of the NEC and ANSI/ANSI/TIA/EIA standards. Designers and installers are encouraged to use the TDMM as an engineering tool, within the constraints of the unique requirements this manual.

Additional BICSI Publications:

BICSI -- Cabling Installation Manual
BICSI -- LAN Design Manual
BICSI – Customer-Owned OSP Design Manual

BICSI publications are available from:

BICSI
8610 Hidden River Parkway
Tampa, FL 33637-1000
1-800-242-7405

10.0 Local Code and Regulatory Compliance

Federal, state, and local codes, rules, regulations, and ordinances governing the work, is as fully part of this manual as if herein repeated or hereto attached. If the contractor should note items in the drawings or the specifications, construction of which would be code violations, promptly call them to the attention of the Owner's representative in writing. Where the requirements of other sections of the specifications are more stringent than applicable codes,

rules, regulations, and ordinances, the specifications should apply.

All pertaining statutes, ordinances, rules, codes, regulations, standards, and the lawful orders of all public authorities having jurisdiction over the construction of telecommunications cable systems will be followed in the design and installation of cabling systems. These include, without limitation, applicable building codes, and handicapped regulations (ADA), municipal codes, fire codes, state statutes and the regulations of the Occupational Safety and Health Administration (OSHA).

11.0 Adherence to Reference Documents

This manual does not exclude any part of the ANSI/ANSI/TIA/EIA standards but may recommend additional practices based upon field experience in state facilities. It is the responsibility of the designer to be familiar with the most current revision of the ANSI/ANSI/TIA/EIA standards and to utilize the standards without exception unless recommended to do otherwise by this manual. Additionally, the designer is responsible to know and comply with all codes. Codes should be enforced; however, where they may differ with standards, the more stringent code requirement should be followed.

12.0 Industry Standard Drawings and Specifications

12.1 Overview

The overall CSI Master-format Construction Drawing package should identify telecommunications drawings as "T-series" numbers. These drawings should be included in addition to the other CSI Divisions if the scope of the telecommunication work justifies this effort. The list of drawings detailed below is for reference only. Some drawing elements may be combined onto a single sheet for smaller projects. Large projects may require all of these drawings and more to convey the intent of the necessary design intent of the telecommunications cabling and support infrastructure. Drawings should be provided to address both interbuilding and intrabuilding telecommunications needs based upon the scope of work developed during the predesign phase of the project.

The following is a list of recommendations concerning drawings which should be used on projects which have a major telecommunications work component.

12.2 Recommended Drawings

T0 Series - - Campus or Site Plans – Exterior Pathways and Inter-building Backbones

T1 Series - - Layout of complete building(s) per floor – Serving Zone Boundaries, Backbone Systems and Horizontal Pathways

T2 Series - - Serving Zones Drawings – Drop Locations and Cable Label ID's

T3 Series - - Detail drawings to scale of the Service Entrance Room (SER), Main Equipment Room (MER) and Telecommunications Rooms (TR) – Detail Plan Views, Telecommunications and AMEP Elevations, Equipment Rack and Wall Mounted Equipment Elevations.

T4 Series - - Typical detail drawings of faceplate labeling, fire stopping, ADA compliance, Safety, DOT, and other detail drawings as necessary to effectively describe both inter-building and intra-building design elements.

T5 Series - Schedules of cabling and equipment spreadsheets for cutovers.

-

T0 Drawings

Show physical and logical connections from the perspective of an entire campus, such as actual building locations, exterior pathways and inter-building backbone cabling on plan view drawings and major system nodes and related connections on the logical system drawings.

Sheet Number	Sheet Title
T0-SP	Physical Site Plan
T0- SL	Schematic/Riser Diagram Site Plan
TO-SP	Pathways Physical - Site Plan
T0-PL	Schematic/Riser Diagram - Site Plan
T0-FP	Physical Fiber Backbone - Site Plan
T0-FL	Schematic/Riser Diagram Fiber Backbone - Site Plan
T0-CP	Physical Copper Backbone – Site Plan
T0-CL	Schematic/Riser Diagram Copper Backbone – Site Plan
T0-LP	Physical Legacy Systems – Site Plan
T0-LL	Schematic/Riser Diagram Legacy Systems – Site Plan
T0-RL	Riser Logical – Site Plan
T0-DL	Data System Logical – Site Plan
T0-TL	Telephone System Logical – Site Plan
T0-VL	Video System Logical – Site Plan
T0-BP	Backbone(s) Physical Plan – Site Plan
T0-BL	Backbone(s) Logical Plan – Site Plan

T1 Drawings

T1 drawings should include layouts of the complete building per floor. The drawing indicates location of serving zones, communication equipment rooms, access points, pathways and other systems that need to be viewed from the complete building perspective.

Sheet Number	Sheet Title
T1-1	Building Plan For The First Floor
T1-PP	Building Pathways Plan View
T1-PL	Building Pathways Logical View
T1-FP	Building Fiber Plan View
T1-FL	Building Fiber Logical Plan
T1-CP	Building Copper Plan View
T1-CL	Building Copper Logical View
T1-XP	Building Coax Plan View
T1-XL	Building Coax Logical View
T1-LP	Building Legacy Systems Logical View
T1-LL	Building Legacy Systems Logical View
T1-RL	Building Riser Logical View
T1-DL	Building Data System Logical View
T1-TL	Building Data System Logical View
T1-VL	Building Video System Logical View
T1-EL	Building Electrical Logical View
T1-BP	Building All Backbone(S) Plan View
T1-BL	Building All Backbone(S) Logical View

T2 Drawings

In these drawings the building is divided up into serving zones. Drawing indicates outlet locations, telecommunications rooms, access points and detail callouts/cross-references for telecommunication room details and other congested areas

Sheet Number	Sheet Title
T2-1B	1B Serving Zone Drawing
T2-CL	Copper Logical Drawing by Riser
T2-PL	Pathway Logical Drawing by Riser

T3 Drawings

T3 drawings should provide a detailed look at telecommunications rooms. Drawings indicate technology layout (equipment racks, ladder rack, MEP layout, equipment rack elevations, and backboard elevations. These could also be an enlargement of congested areas of T1 and T2 drawings.

Sheet Number	Sheet Title
T3-1B	Telecommunications Equipment Room 1B
T3-APB	Access Points for "B" Riser

T4 Drawings

T4 drawings should include detailed drawings of typical symbols such as faceplate labeling, faceplate types, installation procedures, etc.

Sheet Number	Sheet Title
T4-SYM	Sample Symbols Drawing

MISC. Drawings

Additional drawings that may be used in conjunction with the other "T" drawings listed.

Sheet Number	Sheet Title
T5-1	Schedules/spreadsheets to show cutover information and cable plant management
T1-RP	Building Reference Plan/Same Concept as Site Plan
TS-1	On drawing Specifications (Specs. Pasted to a drawing sheet)
T-COVER	Drawing set cover page listing all drawings in the "T" set

Source: www.division17.net

12.3 Recommended Specifications

The telecommunications section of the "specifications" manual should be numbered separately and dis tinctly from other sections. Suggested sections are listed below:

Using Division 16 - Electrical

Section Number	Section Title
16700	General Telecommunications
16705	Inter-Building Pathways
16710	Intra-Building Pathways - Telecommunications
16715	Service Entrance Components - Telecommunications
16720	Main Equipment Room Components - Telecommunications
16725	Computer Room Components - Telecommunications
16730	Audio Visual Room Components - Telecommunications
16735	Telecommunications Room Components - Telecommunications
16740	Horizontal Cabling Components - Telecommunications
16745	Grounding and Bonding Components - Telecommunications
16750	Administration and Labeling - Telecommunications
16755	Certification, Testing and Project Documentation

Using Division 25 – Telecommunications (when officially adopted by CSI)

Section Number	Section Title
25000	General Telecommunications
25005	Inter-Building Pathways
25010	Intra-Building Pathways - Telecommunications
25015	Service Entrance Components - Telecommunications
25020	Main Equipment Room Components - Telecommunications
25025	Computer Room Components - Telecommunications
25030	Audio Visual Room Components - Telecommunications
25035	Telecommunications Room Components - Telecommunications
25040	Horizontal Cabling Components - Telecommunications
25045	Grounding and Bonding Components - Telecommunications
25050	Administration and Labeling - Telecommunications
25050	Certification, Testing and Project Documentation

13.0 Designer and Installer Qualifications

13.1 Telecommunications Designer

a. It is recommended that the telecommunications design firm should have a Building Industry Consulting Services International (BICSI) Registered Communications Distribution Designer (RCDD) on staff or available for consultation.

b. In most circumstances, all drawings and specifications should be reviewed by the "design firms" RCDD and carry the RCDD stamp of approval.

13.2 Telecommunications Installer

a. The designer should require in the specifications that the telecommunications installation contractor must be licensed in the State of Georgia as a Telecommunications Class or Unrestricted Class Low-Voltage Contractor (LVL).

b. The Licensed Low-Voltage Telecommunications Contractor (LVLTC) should be based in the State of Georgia.

c. The designer should require in the specifications that the installation of all cable, equipment, terminations and associated services should be performed by a company that is currently a Manufacturer's Certified Structured Cabling System installer in good standing with minimum of (5) years of experience on similar systems.

d. The designer should require in the specifications that the installation company should have an RCDD on staff performing the role of Project Manager and be available for consultation and to attend project meetings.

e. The designer should require in the specifications that a BICSI certified installer should be, employed by the contractor, and be on site as the installation manager.

13.3 Project Manager

If the telecommunications contractor is the prime contractor, the designer should require in the specifications that there be an on-site, full-time, Project Manager who will act as a single point of contact for all activities regarding this project. The Project Manager will should be required to make on-site decisions regarding the scope of the work and any changes required by the work. The Project Manager must be on the job any time, work is being performed or workers are present. The Project Manager will be totally responsible for all aspects of the work and should have the authority to make immediate decisions regarding implementation or changes to the work.

The Project Manager will should act as a single point of contact for all activities regarding the telecommunications portion of the project. The Project Manager will notify the GTA/RCDD and the telecommunications system designer and the Agency's Inspector of all change requests and inspections. Final approval for change requests must be obtained before commencement of work. Scheduling and coordinating inspections between the LVLTC, the GTA/RCDD and the Agency's Inspector is critical.

13.4 Experience

On all projects, the designer should require in the specifications that the selected LVLTC be fully capable and experienced in the installation of telecommunications distribution systems and have a minimum of five (5) years of experience installing Structured Cabling Systems. To ensure the system has continued support, the State/GTA/Agency will contract only with a LVLTC having a successful history of structured cabling system installations.

The LVLTC should have an RCDD on staff that who will be ultimately responsible for this project. The RCDD should have sufficient experience in this type project and be able to lend adequate technical support to the field forces during installation, during the warranty period and during any extended warranty periods or maintenance contracts. The credentials (current BICSI certification stamp) of the responsible RCDD must be attached to the LVLTC's response for evaluation by the State/Agency/GTA. Should the RCDD assigned to this project change during the installation, the new RCDD assigned must also submit same credentials for review by the State/Agency/GTA. The State/Agency/GTA reserves the right to require the LVLTC to assign another RCDD whom, in the State/Agency/GTA's opinion, possesses the necessary skills and experience required.

13.5 References

The state may, with full cooperation of the LVLTC, visit installations to observe equipment operations and consult with references. Specified visits and discussion should be arranged through the LVLTC; however, the LVLTC personnel should not be present during discussions with references. The LVLTC must provide a minimum of three

(3) reference accounts at which similar work, both in scope and design, have been completed by the LVLTC within the last two (2) years.

13.6 Prime Vendor

In the event multiple Vendors submit a joint response to the RFQ, a single Vendor should be identified as the Prime Vendor. Prime Vendor responsibilities should include performing overall project administration and serving as a focal point for the state to coordinate and monitor plans, schedules status information and administer changes required. The Prime Vendor should remain responsible for performing tasks associated with installation and implementation of the entire telecommunications project.

14.0 Overall Quality Assurance

1. The designer should design in accordance with the BISCI Telecommunications Distributions Methods Manual and ANSI/ANSI/TIA/EIA standards.

2. The Licensed Low Voltage Telecommunications Contractor (LVLTC) should install work in accordance with the BICSI Cabling Installation Manual.

3. Periodic inspections will be part of the quality assurance.

15.0 Submittals and Document Review

1. Before installation of any cable or support equipment the LVLTC should submit shop drawings and product data for the GTA/RCDD and designer for review and approval.

2. The LVLTC should indicate installation details, cable routing, system configuration, and outlet numbering on all drawings.

3. The LVLTC should submit all appropriate product data for each component to be supplied.

4. The LVLTC should submit manufacturer's installation instructions.

16.0 Project Record Documents

1. The designer should require in the specifications that the LVLTC should submit three copies of a complete, bound, project record manual consisting of the following:

- Product cut sheets for all products supplied
- Test reports for horizontal cabling
- Test reports for backbone cabling
- Manufacturer’s warranties
- “D-size” As-built drawings

2. As-built drawings should accurately record location of service entrance conduit, termination backboards, outlet boxes, cable raceways, cable trays, pull boxes, and equipment racks electronically using AutoCAD 14 or later version and on a minimum “D” size reproducible paper prints.

3. The designer should require in the specifications that the LVLTC should prepare 11” x 17" as-built serving zone drawings for each TR. The drawings should be laminated, framed and secured to the wall in the MER and TR.

17.0 Post Construction Warranties and Other Requirements

The designer should require in the specifications that the LVLTC furnish a warranty of products, applications and workmanship for 15 years from the date of acceptance by the state. All other products and workmanship should carry warranties equal to or greater than the warranty from the date of acceptance by the state.

The designer should require in the specifications that materials and workmanship be fully guaranteed by the LVLTC for fifteen years from transfer of title against any defects. The designer should require in the specifications that the defects which may occur, as the result of faulty materials or workmanship within fifteen years after installation and acceptance by the Agency should be corrected by the LVLTC at no additional cost to the Agency. The designer should require in the specifications that the LVLTC should promptly, at no cost to the Agency, correct or re-perform (including modifications or additions as necessary) any nonconforming or defective work within fifteen years after completion of the project of which the work is a part. The period of the LVLTC's warranties for any items herein should not bear not exclusive remedies, and the Agency Owner should have recourse to any warranties of additional scope given by LVLTC to the Agency and all other remedies available at law or in equity. The LVLTCs warranties should commence with acceptance of/or payment for the work in full.

If the LVLTC procures equipment or materials under the contract, the LVLTC should obtain for the benefit of the Agency equipment and materials warranties against defects in materials and workmanship to the extent such warranties are reasonably obtainable.

The designer should require in the specifications that the LVLTC should pass along to the Agency Owner any additional warranties offered by the manufacturers, at no additional costs to the Agency.

This warranty should in no manner cover equipment that has been damaged or rendered unserviceable due to negligence, misuse, acts of vandalism, or tampering by the Agency or anyone other than employees or agents of the LVLTC. The LVLTC's obligation under its warranty is limited to the cost of repair of the warranted item or replacement thereof, at the LVLTC's option. Insurance covering said equipment from damage or loss is to be borne by the LVLTC until full acceptance of equipment and services.

18.0 The Georgia Technology Authority (GTA)

- The designer is reminded that the State of Georgia is the owner of all property and completed projects, unless otherwise specified in the project.

- The Georgia Technology Authority (GTA) is responsible for all telecommunications systems in all state owned or leased buildings.

- GTA is represented by regional GTA/Registered Communications Distribution Designers (GTA/RCDD) during the design and construction of capital facilities for the state. The RCDD will assist the design team and the other trade representatives throughout the design and construction process.

- GTA reserves the right to send the RCDD as representative to attend construction meetings.

- The GTA/RCDD should help resolve issues concerning the telecommunications infrastructure during design and construction.

19.0 Role of the GTA Registered Communications Distribution Designer

- The designer of the telecommunications system can take advantage of the assistance that can be provided by the GTA Registered Communications Distribution Designer (RCDD). The GTA/RCDD can assist by advising and assisting state agencies with planning, designing and inspection of the structured cabling systems and associated infrastructure installed statewide. This includes pre-design, schematic design and construction

design stages of each project. Elements included are drawings, plan sets and technical specifications for telecommunications.

- GTA reserves the right to send its GTA/RCDD as a representative to inspect the job site(s) during construction to ensure compliance with this telecommunications manual and all associated telecommunications codes and standards.

- The GTA/RCDD should be included in all phases of the project from the first preliminary meeting to the final walk-through, including each architectural, engineering, and construction phase as per the published Statewide Construction Manual, Administrative Procedures for Telecommunications.

- Providing input to the design and implementation of the telecommunications infrastructure.

- Providing final approval of the details of the specifications for the voice, data, and video cabling recommendations at each phase and milestone of the project.

- Serving as a single point of contact for coordinating and provisioning of telecommunications services of new construction, renovations and additions to each facility and for all other associated tasks required for service and support provided through GTA.

- Developing, promulgating and maintaining guidelines, standards and this manual for the construction and management of cabling system technology in the state.

- Assists with developing statewide standards for the efficient exchange of electronic information and technology related to infrastructure, cabling and support systems with the public and private sectors in the State.

- Assists with the formulation of specifications for telecommunications systems to transport voice, data and video signals. Maintains approved lists of products and devices to be used.

- Assists with the analysis and approval of telecommunications facilities and other communications equipment and goods.

- Assists with the review and approval of agreements and contracts for communications distribution design and construction services prior to execution between state agencies and other public or private agencies.

- Maintains and administers an electronic database system to monitor and evaluate executed cabling contracts.

- Review all requests for waivers or deviations from this manual or other standard. **No waivers or deviations from codes will be allowed**. All state approved safety regulations must be adhered to and the GTA/RCDD will work closely with code officials and the State Fire Marshall's Office to assure compliance.

20.0 Role of the State Agency

The designer of the telecommunications system should be aware of the role of the State Agency. The State Agency can assist in the following roles:

- To establish a budget for telecommunications and to provide financial support for the telecommunications system(s).

- Ensure that a virtual team for the design and implementation of telecommunications is established and should include the following participants at a minimum: 1) the Architect, 2) the GTA/RCDD, 3) the Agencies IT representative and 4) the Agencies Project Manager and other participants as necessary.

- Assure compliance with GTA policies, codes, standards and this Telecommunications Design Manual.

- Ensure that only professionals licensed to operate within the State of Georgia are allowed to install telecommunications cabling and support infrastructure.

21.0 Recommendations for Networking Telecommunications Cabling

The following recommendations address various aspects of providing and managing the telecommunications cabling infrastructure needed for effective voice, data, and video telecommunications services in Georgia facilities. This infrastructure is a critical resource needed to conduct the business of the State of Georgia. Recommendations are discussed using the telecommunications and networking reference layers of the Open Systems Interconnect - Seven Layer Model, also called the OSI model.

The physical network layer addresses signal transmission media, connectors, and related devices. The State of Georgia bases its physical layer cabling standards on the current release of ANSI/ANSI/TIA/EIA 568-B.1, B.2, and B.3 (i.e., the second release of ANSI/ANSI/TIA/EIA-568 divided into parts 1, 2, and 3).

Also, related to the physical layer is the ANSI/ANSI/TIA/EIA standard that specifies recommendations for pathways and spaces utilized for support of telecommunications cabling. ANSI/ANSI/TIA/EIA 569-A, Commercial Building Telecommunications Pathways and Spaces, provide recommendations geared to the typical office. ANSI/ANSI/TIA/EIA 569-A provides information on floor pathways, ceiling pathways, perimeter pathways and other pathways that support telecommunications cabling. The standard covers conduit, junction/pull boxes, cable trays, room sizes, and other aspects for routing cable throughout and between buildings. Other areas discussed in the ANSI/ANSI/TIA/EIA 569-A standard are work areas, Equipment Rooms (ER), Telecommunications Rooms (TR), and telecommunications service Entrance Facilities (EF). ANSI/ANSI/TIA/EIA 569-A ensures that proper pathways and minimum space recommendations support cable protection and cable maintenance activities with sufficient capacity for potential future growth. This information should be used by; state agencies, Architects, Engineers and Consultants; and others involved with the design and implementation of telecommunications system pathways and spaces for both, state owned facilities and leased space.

Recommendation 1:

Agencies should install standards-based structured cabling systems for telecommunications.

Agencies should employ standards-based designs, topologies, and components, maintain distance limitations, installation methods, cable testing and administration whether for cabling in new construction for cabling plant additions or modifications; or for building renovations and additions. Also, agencies must require standards-based installations in leased spaces. All minimum recommendations or mandatory criteria addressed in ANSI/ANSI/TIA/EIA 568-B.1, B.2 and B.3 should be met unless exceptions are noted in this manual.

The three ANSI/ANSI/TIA/EIA 568 standards are discussed in more detail below:

- **ANSI/ANSI/TIA/EIA-568-B.1, Commercial Building Telecommunications Cabling Standard, Part 1: General Recommendations.**

This ANSI/ANSI/TIA/EIA standard addresses cabling infrastructure design, installation and field testing for horizontal cabling, backbone cabling, and work areas. It also covers recommendations for telecommunications rooms, equipment rooms, and entrance facilities. The ANSI/ANSI/TIA/EIA standard is used in conjunction with local electrical codes and standards to provide an appropriate cabling plant.

- **ANSI/ANSI/TIA/EIA-568-B.2, Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted Pair Cabling Components.**

This ANSI/ANSI/TIA/EIA standard addresses specifications for horizontal 4-pair cables and backbone multi-pair cables and components. Both Category 5E and Category 3 cable specifications and laboratory testing are addressed. Field tester specifications and additional field testing recommendations are incorporated into this manual.

- **ANSI/ANSI/TIA/EIA-568-B.2-1, Addendum 1 – Transmission Performance Specifications for 4-pair 100 ohm, Category 6 Cabling**

The addendum addresses Category 6 Balanced twisted-pair cabling systems and components. Category 6 cabling provides higher performance than Category 5e as specified by ANSI/ANSI/TIA/EIA -568-B.1 and ANSI/ANSI/TIA/EIA-568-B.2

- **ANSI/ANSI/TIA/EIA-568-B.3, Commercial Building Telecommunications Cabling Standard**, Part 3: Optical Fiber Cabling Components Standard.

This ANSI/ANSI/TIA/EIA standard addresses multimode (50/125 µm and 62.5/125 µm) and single mode fiber optic cabling components, transmission standards and field testers.

Note: The State of Georgia recommends one major modification to the ANSI/ANSI/TIA/EIA 568 B.2 cabling standard. In this standard, Category 3 cable is permitted. GTA does not recommend any new installations of Category 3 horizontal cable without a written waiver (see appendix X). For new installations, GTA recommends only ETL verified, Category 5e or Category 6 cabling and components. Utilizing Category 5e as a minimum or Category 6 horizontal cabling will enable a consistent upward migration path for agencies, ensuring higher bandwidth transmission capabilities over copper cabling to provide a migration path to meet future needs.

ANSI/ANSI/TIA/EIA 568-B.1, B.2, and/or B.3 should not be confused with T568A or T568B, which address eight position jack pin/pair assignments. ANSI/ANSI/TIA/EIA 568-B standards supersede the following: ANSI/ANSI/TIA/EIA 568-A, 568-A Addenda 568 A-1 through 568 A-5, TSB67, TSB72, TSB75, TSB95, and ANSI/ANSI/TIA/EIA/IS729.

Recommendation 2:

Agencies should plan and budget for installation of manufacturer's performance warranted structured Category 5e or Category 6 cabling systems when installing new or replacement telecommunications cabling.

In a typical office, a minimum of two Work Area Outlets should be provided. Each Work Area Outlet should include two Category 5E or two Category 6 jacks. In some cases fiber to the desktop and video cabling may also be required.

Recommendation 3:

ANSI/ANSI/TIA/EIA 568-B.3, addresses fiber optic cabling. The revised ANSI/ANSI/TIA/EIA-568-B.3 standard adds the 50/125, micron fiber type. All connector types that are designed to organize and manage the fiber strands in pairs are the subjects of a FOCIS (Fiber Optic Connector Inter-mateability Standard) document. This document incorporates performance standards for connectors, and specifies connecting hardware recommendations

Recommendation 4:

Agencies are expected to provide appropriate pathways and spaces for telecommunications cabling and equipment by implementing the minimum recommendations of **ANSI/ANSI/TIA/EIA 569-A, Commercial Building Telecommunications Pathways and Spaces** and all related addenda.

Pathway and room size recommendations must be adjusted for higher and lower densities of telecommunications outlets and for additional equipment over and above what is expected in the average situation.

The GTA/RCDD should be contacted to review plans for these spaces as early as possible in the planning process.

Recommendation 5:

Agencies should follow grounding and bonding recommendations specified in **ANSI/ANSI/TIA/EIA 607, Commercial Building Grounding and Bonding recommendations for Telecommunications**.

ANSI/ANSI/TIA/EIA 607 provides grounding and bonding specifications for telecommunications circuits and equipment. A ground provides a low impedance path to the earth. Proper grounding helps to reduce potential damage to equipment and personnel. Bonding refers to the connections between or bridging of two parts of a grounding system.

Recommendation 6:

Agencies changing their LAN services should migrate to a minimum of IEEE 802.3 Fast Ethernet (100 Mbps Switched Ethernet) or to a higher bandwidth Ethernet service 802.3, full duplex Fast Ethernet, 802.3ab Gigabit Ethernet over copper, or 802.3z Gigabit Ethernet over fiber). Agencies should use an access method within the above specified migration path depending on their particular bandwidth needs. It is not necessary for agencies to know the details in the IEEE 802.3 standard as it relates to cabling systems.

Recommendation 7:

All agencies should employ methods for administering telecommunications infrastructure that are compliant with ANSI/ANSI/TIA/EIA 606-A, Administration Standard for the Telecommunications Infrastructure of commercial Buildings.

ANSI/ANSI/TIA/EIA 606-A addresses the labeling of the cabling infrastructure using a uniform administration scheme that must be utilized by installation vendors. This enables the scheme to remain constant even though the user may change vendors, cable installation contractors, or cable management personnel. The standard addresses such recommendations as cable labels must be legible, must be attached at appropriate points, splices and intervals, must be well attached and must be protected from the environment.

B. BUILDING INFRASTRUCTURE /INTRABUILDING DESIGN ELEMENTS

1.0 Telecommunications Spaces Overview

The design of spaces to house telecommunications cabling and equipment should follow ANSI/ANSI/TIA/EIA 569-A: Commercial Building Standard for Telecommunications Pathways and Spaces (1998) and all addenda to this standard.

All rooms used for telecommunications, including telecommunications Service Entrance Facilities (EF), the Main Equipment Rooms (MER), and Telecommunication Rooms (TR) should be dedicated to the sole use of Telecommunications. No other building facility equipment should be housed in any Telecommunication Room including, but not limited to, fire alarm systems, monitoring systems, security systems, janitorial services, supply storage, departmental storage, etc. .

GTA recommends that the agency and AEC team plan for telecommunications rooms to be strategically placed so that horizontal cabling will not exceed 250' from the termination panel in the TR to the Work Area Outlet (WAO) location.

The GTA/RCDD should be given authority to review intended use, location and size of all rooms and recommend changes to the architectural plans.

2.0 Telecommunications Service Entrance Facilities

2.1 General

The Telecommunications Service Entrance Facilities (EF) is where all telecommunications (voice, data and video) cabling enters the building. This room provides space for the placement and termination of cable protectors on entrance cables and may contain network interface devices. It is acceptable for the EF room and the MER to be one and the same room but may be separate rooms in larger facilities. In general a dedicated entrance facility room does not require environmental conditioning since electronic equipment is typically housed in a separate ER. When both rooms are combined design specifications for the ER should be followed and the size of the EF/MER should be increased accordingly to accommodate for the required equipment of both rooms.

2.2 Location

All carriers and telecommunications providers providing service to the facility should be contacted through the GTA/RCDD to determine their requirements. The location of other utilities, such as electrical, water, gas and sewer should be considered.

Multiple/diverse entrances may be required where security, redundant service, or other special needs exist.

Without exception the EF room should always be located in a dry area, not subject to flooding, on the ground floor and on an exterior wall. To comply with NEC the SER must be near to the electrical service entrance room.

Equipment not related to the support of the EF room (e.g., piping, ductwork, pneumatic tubing, etc.) should not be installed in, enter or pass through the room.

2.3 Size

The EF room should be sized to meet the known requirements of the specific Building Entrance Terminals (BET)/lightning protection to be installed and to provide for termination, splicing or transition to building cabling i.e., riser or plenum rated cables. Sizing should include projected future and present requirements.

2.4 Provisioning

A minimum of one wall should be covered with rigidly fixed, ¾ inch, A-C grade, void free, plywood installed 6 inches above the finished floor (AFF) to 8 feet 6 inches AFF, capable of supporting Building Entrance Terminals (BETs) and other wall mounted telecommunications devices. The Plywood should be fire-rated and covered with two coats of white "fire retardant" paint on all sides of the plywood sheet prior to installation.

Lighting should be a minimum of 50 foot-candles measured 3 feet AFF and mounted 8 feet 6 inches AFF and controlled by a switch adjacent to the entrance door. At least one lighting fixture within the room should be on the emergency lighting circuit for the facility.

False ceiling should not be provided in the EF

The entrance door should be a minimum of 36 inches wide and 80 inches high and fitted with a lock and should open into and be accessible from inside the facility. Entrance doors should not open to the exterior of facility.

Floors, walls and the ceiling should be treated to eliminate dust. Finishes should be light in color to enhance lighting.

2.5 Electrical Power

A minimum of two dedicated 120Volt, nominal, non-switched, duplex electrical outlet receptacles, each on a separate branch circuit, should be provided. Each receptacle should be rated at 20 Amps and should be connected to a dedicated 20 Amp branch circuit.

Additional convenience duplex electrical receptacles should be placed along the wall, spaced every 6ft and 6in AFF.

2.6 Grounding and Bonding

Access to the telecommunications grounding system specified by ANSI/ANSI/TIA/EIA-607 is mandatory.

2.7 Fire Suppression Sprinklers

If sprinklers are required by fire code, the heads should be protected with wire cages to prevent accidental operation. Drainage troughs should be placed under the sprinkler pipes to prevent leakage onto the equipment within the room. Consideration should be given to the installation of alternate fire-suppression systems or a dry pipe system.

2.8 Auxiliary Fire Extinguishers

Portable fire extinguishers should be provided and maintained within the MER per applicable code.

2.9 Entrance Pathways

In determining the total number of pathways required the designer should consider the following:

1. Type and use of the building
2. Growth potential
3. Difficulty in adding pathways in the future
4. Alternate/redundant entrance
5. Type and size of cables to be installed

As per NFPA 70 Article 800-11(c), (1999) the point of entry for telecommunications wiring and cables should be within 20 ft of the electrical service entry point.

OSP (OSP) cables will enter the room from the nearest manhole, utility pole, or other Service Provider location. Conduits should be extended from the EF room to the location

There should be a minimum of three (3) 4" conduits installed from the EF room to the utility pole, manhole, handhole or duct bank for each service being provided to the facility (Voice/Telephone Service, Data/LAN Service and Video/CATV/SMATV Service). In some cases fewer conduits may be allowed based on the building usage.

3.0 Main Telecommunications Equipment Rooms

3.1 General

The Main Telecommunications Equipment Room (MER) houses all of the telecommunications equipment to support the building and interconnect the building to the campus' MER. Typically, the MER additionally serves as the Telecommunications Room for the surrounding section of the building, and therefore should be the largest of the three types of rooms used for telecommunications in the building.

3.2 Location

Locations that limit expansion such as elevators and the building core should be avoided.

Accessibility for the delivery of large equipment should be provided.

If the MER and EF rooms are combined then the MER/EF room must be located on an outside wall on the ground floor.

3.3 Layout

Telecommunications equipment layouts within the MER should be verified with the equipment providers for weight and distance limitations between equipment racks. Scaled detail drawings of the MER layout should be provided to ensure that clearances required by the NEC are provided and that there will be sufficient capacity for future expansion

3.4 Provisioning

Plywood backboards should be provided as shown on drawings. A minimum of one wall should be covered with rigidly fixed, ¾ inch, A-C grade, void free, plywood installed 6 inches above the finished floor (AFF) to 8 feet 6 inches AFF, capable of supporting the BET and other wall mounted telecommunications devices. The Plywood should be fire-rated and covered with two coats of white "fire retardant" paint on all sides of the plywood sheet prior to installation.

Lighting should be a minimum of 50 foot-candles measured 3 feet AFF and mounted 8 feet 6 inches AFF and controlled by a switch adjacent to the entrance door. At least one lighting fixture within the room should be on the emergency lighting circuit for the facility.

False ceiling should not be provided in the MER.

The entrance door should be a minimum of 36 inches wide and 80 inches high and fitted with a lock and should open into and be accessible from inside the facility. Entrance doors should not open to the exterior of facility.

Floors, walls and the ceiling should be treated to eliminate dust. Finishes should be light in color to enhance lighting.

3.5 Floor Loading

Minimum distributed load rating: 100 lbf/ft^2

Minimum concentrated load rating: 2,000 lbf.

If heavy equipment is anticipated these figures should be increased.

3.6 Water Infiltration

The room should not be located below water level unless preventative measures against water infiltration are provided.

The room should be free of water or drain pipes not directly required in support of the equipment within the room.

A floor drain should be provided within the room if a risk of water ingress exists.

3.7 Electromagnetic Interference

The room should be located away from sources of electromagnetic interference i.e., electrical power supply transformers, electric motors and generators, x-ray equipment, magnetometers, radio or radar transmitters and induction sealing devices.

3.8 Vibration

Potential vibration problems should be considered since excessive vibration can lead to loosened connections.

3.9 Size

Typically provide .75 ft^2 of equipment room floor space for every 100 ft^2 of work area floor space. The minimum size should be 150 ft^2. If it is expected that the density of work areas will be higher, then the size should be increased accordingly. In multi-tenant facilities a decision should be made whether the equipment will be located in a common equipment room or in the tenant space. The size of the equipment room should be increased to accommodate multiplicity of equipment.

Minimum Termination Wall Length

Gross Floor Space Served (Ft^2)	Wall Length (in)
10,000	39
20,000	42
40,000	68
50,000	90
60,000	96
80,000	120
100,000	144

Source: ANSI/ANSI/TIA/EIA-569-A Commercial Building Standard for Telecommunications Pathways and Spaces

Minimum Termination Floor Space

Gross Floor Space Served (Ft^2)	Floor space dimensions (ft)
100,000	12 x 6.5
200,000	12 x 9.0
400,000	12 x 13.0
500,000	12 x 15.5
600,000	12 x 18.5
800,000	12 x 22.5
1,000,000	12 x 27.5

Source: ANSI/ANSI/TIA/EIA-569-A Commercial Building Standard for Telecommunications Pathways and Spaces

Special recommendations are necessary for special-use facilities (e.g., hotels, hospitals and laboratories) or non-traditional office space. In special-use facilities the equipment room floor space should be based upon the known number of work areas and not on usable floor space as follows:

Work Areas Served (ft^2)	Floor Space Required (ft^2)

Up to 100	150
101 to 400	400
401 to 800	800
801 to1,200	1,200

Source: ANSI/ANSI/TIA/EIA-569-A Commercial Building Standard for Telecommunications Pathways and Spaces

3.10 Clearance Height

Minimum clear height in the room should be 8 feet without obstructions.

3.11 Contaminants

The following table indicates the maximum allowable contaminants in the equipment room. If concentrations are present in quantities greater than indicated then vapor barriers, positive room pressure or absolute filters should be provided.

Contaminant	**Concentration**
Chlorine	0.01 ppm
Dust	100.0 µg/m^3/ 24 hours
Hydrocarbons	4.0 µg/m^3/ 24 hours
Hydrogen Sulfide	0.05 ppm
Nitrogen Oxides	0.1 ppm
Sulfur Dioxide	0.3 ppm

Source: ANSI/ANSI/TIA/EIA-569-A Commercial Building Standard for Telecommunications Pathways and Spaces (1998)

3.12 Backbone Pathway

The equipment room will need to be connected to the backbone pathway for cabling to the telecommunications SER, and the TRs.

3.13 Fire Suppression Sprinklers

If sprinklers are required by fire code, the heads should be protected with wire cages to prevent accidental operation. Drainage troughs should be placed under the sprinkler pipes to prevent leakage onto the equipment within the room. Consideration should be given to the installation of alternate fire-suppression systems or a dry pipe system.

3.14 Auxiliary Fire Extinguishers

Portable fire extinguishers should be provided and maintained within the MER per applicable code.

3.15 Environmental Conditioning

HVAC should be provided on a 24 hours-per-day, 365 days-per-year basis. If the building HVAC system cannot assure continuous operation in the equipment room then a stand-alone unit should be provided. If a standby power source is provided for the facility, consideration should be given to connecting the HVAC serving the telecommunications equipment room to the standby supply.

The ambient room temperature and humidity should be measured at a distance of 5ft AFF, after the equipment is in operation, at any point along a telecommunications equipment aisle.

Temperature and humidity should be controlled to provide continuous operating ranges of 64°F TO 75°F with 30% to 55% relative humidity measured.

A positive pressure differential with respect to surrounding areas should be provided.

If batteries are used within the equipment room for backup, adequate ventilation should be provided.

The MER room shall should be treated with conditioned air and equipped with a separate thermostat to maintain the conditioned air. Heat load requirements should be based upon actual equipment to be installed plus a reasonable growth factor.

Typical minimum requirements are as follows:

MER Room Size	**Heat Dissipation**
8' x 16'	6,000 BTU/Hr.
8' x 20'	7,500 BTU/Hr.
10' x 24'	13,000 BTU/Hr.
14' x 24'	16,000 BTU/Hr.
18' x 28'	25,000 BTU/Hr.
20' x 32'	30,000 BTU/Hr.
20' x 36'	34,000 BTU/Hr.
24' x 40'	45,000 BTU/Hr.

3.16 Interior Finishes

The floors walls and ceilings should be sealed to reduce dust. Finishes should be light in color to enhance room lighting. Floors should be covered with light colored, anti-static vinyl tile.

3.17 Lighting

Lighting should be a minimum of 50 foot-candles measured 3 feet AFF and mounted 8 feet 6 inches AFF and controlled by a switch adjacent to the entrance door. At least one lighting fixture within the room should be on the emergency lighting circuit for the facility.

3.18 Ceilings

False ceiling should not be provided in the MER

3.19 Entrance Door

The entrance door should be a minimum of 36 inches wide and 80 inches high and fitted with a lock and should open into and be accessible from inside the facility. If a double door is provided there should not be a center post. Entrance doors should not open to the exterior of facility.

3.20 Electrical Power

In some instances a separate supply circuit serving the MER should be provided and terminated in its own electrical sub panel, located in the electrical room.

If a standby power source is provided for the facility the equipment room panel should be connected to the standby power.

Each equipment rack that will have active telecommunications equipment installed should be provided with a surge-protected multiple outlet strip(s) that is hard wired to a dedicated 20Amp circuit in a junction box attached to the structure above the equipment rack. Additional dedicated 20Amp duplex electrical receptacles should be surface mounted on walls adjacent to any wall mounted telecommunications equipment.

Additional convenience duplex electrical receptacles should be placed along the wall, spaced every 6ft and 18in AFF. All receptacles in the MER should be isolated grounding type.

3.21 Equipment Grounding

Access should be made available to the telecommunications grounding system specified by ANSI/ANSI/TIA/EIA – 607 - Commercial Building Grounding and Bonding Requirements for Telecommunications (1994)

4.0 Telecommunications Rooms

4.1 General

The Telecommunications Room (TR) on each floor is the recognized location of the common access point for backbone and horizontal pathways. These rooms have specific recommendations due to the nature, size and complexity of the equipment and cabling housed within the room.

TRs must be able to contain telecommunications equipment, cable terminations and associated cross-connect cabling. Telecommunication rooms must have the space and environmental facilities required by the electronic equipment used in today's networks, including hubs, switches, terminal concentrators, backbone multiplexing systems, fiber optic patch panels, horizontal cabling patch panels and other devices

TR space should be dedicated to the telecommunications function and related support facilities.

TRs should not be shared by other building services such as Electrical (i.e. Electrical Distribution Panels or Transformers) or custodial services (i.e. cleaning carts, solvents, buffers, etc.). Either pose a threat of damage or EMF interference that makes them totally unacceptable for telecommunications equipment & cabling TRs should not contain any type of sink, water heater or be used as storage for custodial or any other such supplies.

Telecommunications Rooms should never be used for storage of any kind. (I.e. books, furniture, A/C filters, light Bulbs, etc…)

Equipment not related to the support of the TR (e.g., piping, ductwork, pneumatic tubing, etc.) should not be installed, pass through or enter the TR.

4.2 Size and Spacing

There should be a minimum of one TR per floor. Additional TRs (one for each area up to 10,000 ft^2) should be provided when the floor area to be served from the TR exceeds 10,000 ft^2; or the distance of the horizontal distribution to the work area exceeds 250 ft.

Each TR should serve an area that will allow all horizontal cables to be less than 250 ft from the termination location in the TR to any WAO location.

Based upon one work area per 100 ft^2, the TR should be sized as follows

Serving Area (ft^2)	Room Size (ft)
10,000	10 x 12
8,000	10 x 10
5,000	10 x 8

Source: ANSI/ANSI/TIA/EIA-569-A Commercial Building Standard for Telecommunications Pathways and Spaces

4.3 Location

TRs should not be located near or under bathrooms, laundry rooms, kitchens, or janitorial sinks.

All TRs should be vertically aligned and located near the middle of each floor and within 250 ft of each other and all work area outlets.

TRs should have direct access to the hallway or other such corridor and one wall of the TR should be a hallway wall.

4.4 Room Shape and Size

All Telecommunication Rooms should be rectangular in shape. It is unwise to designate rooms with curved walls or odd shapes for Telecommunication rooms.

TRs should not be located so that building columns take up space within the room.

In general, each room must be large enough to accommodate the cabling and telecommunications equipment located within the room, plus additional space for growth. As per NFPA 70 Article 110-26 a 3' service area is required around all UPS equipment, telecommunication equipment racks, wall mounted telecommunications equipment and electrical panels.

GTA should be contacted for review and approval of final dimensions and locations of all Telecommunication Rooms.

4.5 Plywood Backboards

Void free, fire resistant, ¾" AC grade plywood (minimum) should be installed where shown on drawings or all four walls of the SER, MER and all TRs. The sheets of plywood should be mounted 6"AFF at the bottom to a height of 8'6"AFF.

4.6 Room Lighting

Lighting should be a minimum of 50 foot-candles measured 3 feet AFF and mounted 8 feet 6 inches AFF and controlled by a switch adjacent to the entrance door. At least one lighting fixture within the room should be on the emergency lighting circuit for the facility.

4.7 Conduit and Sleeves

There should be a minimum of 4-4" sleeves installed on the inside wall at a height that will be above the finished hallway ceiling and extending into the hallway to the cable tray for horizontal pathways.

There should be a minimum of 4-4" sleeves installed in the floor and in the ceiling for riser cabling to telecommunications closets that are located on the floors above or below the equipment room.

4.8 Environmental Conditioning Recommendations

Equipment Rooms and Telecommunication Rooms should be provided with adequate HVAC equipment to maintain a constant temperature and humidity level throughout the day, evening, weekend and holiday time frames. Heat load should be based upon equipment to be installed by the agency plus a growth factor.

4.9 Cable Support Ladder Rack

The location of ladder rack in the TRs should be shown on scaled detail drawings of each TR. A continuous pathway of cable support ladder rack should be installed 84 inches AFF from the point that the horizontal conduits or sleeves enter the room. The ladder rack should continue around the perimeter of the room and above all equipment racks and cabinets.

All necessary triangular wall support brackets, T-junction splices, equipment rack attachment plates, cable drop outs and other accessories should be provided and shown on the detail drawings.

All Equipment Rooms, Telecommunications Rooms, and Entrance Facility rooms should have ladder rack provided around the perimeter of the room.

A minimum of 12" wide ladder rack should be used for the pathway to the racks.

Ladder Rack should be installed vertically with wall stand-offs from the floor to the ceiling vertical riser sleeves to support backbone cabling, passing vertically through the room.

Each section of all ladder rack should be bonded with braided bonding straps and bonded to the telecommunications ground in the room.

All ladder rack should be installed as per manufacturer's recommendations.

4.10 Telecommunications Rooms Entrance Doors

The designer of the telecommunications system should specify that all doors for Telecommunication Rooms be a minimum of 36" x 80" with an outward swing.

If a double door is provided the door should have no center posts or sills.

Entrance doors should not open to the exterior of the facility.

4.11 Room Ceilings

False ceilings should not be provided in any Telecommunication Space

The minimum clear height in all telecommunication spaces should be at least 8 feet without obstructions.

4.12 Room Flooring

Cover with light colored anti-static vinyl tile

Schedule the tile installation at least one week before telecommunication equipment rack installation.

4.13 Electrical Power

In some instances a separate supply circuit serving the MER and TRs should be provided and terminated in its own electrical sub panel, located in the electrical room.

If a standby power source is provided for the facility the equipment room panel should be connected to the standby power.

Each equipment rack that will have active telecommunications equipment installed should be provided with a surge-protected multiple outlet strip(s) that is hard wired to a dedicated 20Amp circuit in a junction box attached to the structure above the equipment rack. Additional dedicated 20Amp duplex electrical receptacles should be surface mounted on walls adjacent to any wall mounted telecommunications equipment.

Additional convenience duplex electrical receptacles should be placed along the wall, spaced every 6ft and 18in AFF. All receptacles in the MER should be isolated grounding type.

4.14 Equipment Grounding

Access should be made available to the telecommunications grounding system specified by ANSI/ANSI/TIA/EIA – 607 - Commercial Building Grounding and Bonding Requirements for Telecommunications (1994)

4.15 Telecommunications Room Work Area Outlets

A minimum of one WAO with 2 data and 2 voice outlets should be provided within the room.

One wall mounted analog telephone with a long handset cord should be provided near the equipment racks.

4.16 Fire Protection

Fire protection should meet state and local building codes.

There should be at least one fire extinguisher rated for electrical fires placed near the entry to the SER, MER and TR.

Any wet sprinkler heads installed within telecommunication spaces must be provided with caged protection.

It is recommended that alternate fire-suppression systems should be used.

5.0 Other Telecommunications Spaces

5.1 Audio/Video Equipment Rooms/Spaces

Depending upon the requirements of the facility for Audio/Video (A/V) equipment it may be necessary to provide dedicated spaces/rooms for this equipment. A/V equipment should only be housed in telecommunications rooms if adequate additional space is provided in the TR. If a large quantity of A/V equipment is required then rooms dedicated to A/V should be provided. It may be beneficial to hire an A/V consultant to design this type of space.

5.2 Computer Rooms

Typically the Main Computer Room is space dedicated solely to housing multiple computer servers, Main Frame computers, Supercomputers, large PBXs and other computer equipment that is typically housed in telecommunications equipment cabinets on top of a raised floor within the room. While it may be necessary to install

network equipment in this room for connectivity to the computer equipment, design of this room is beyond the scope of this document. There should, however be sufficient conduit and backbone cabling interconnecting the Main Computer Room to the Main Telecommunications Equipment Room and the other telecommunications rooms in the building.

Access floors in computer rooms should be installed in accordance with ANSI/ANSI/TIA/EIA -569-a, Commercial Building Telecommunications Pathways and Spaces – Addendum 3 –Access Floors.

5.3 Shallow Telecommunications Rooms

In existing or retrofit buildings, minimum TR sizes may not be possible. If the use of, a shallow room is approved by the GTA/RCDD and the Agency, the minimum dimensions shall should be 6' deep by 8'6" wide by 8' high. The door to the room should be a minimum of 36 inches wide. If a double door is used, the center post should be eliminated. Due to space limitations and safety concerns, no equipment other than punch down blocks and wall-mounted equipment should be housed in this size room. Refer to NFPA 80: A shallow communications room is acceptable only for areas that are less than 1000 square feet.

6.0 Backbone Pathways

In multi-level structures, the MER and TRs should be designed in a stacked configuration, i.e., one room above the other. A quantity of four, four-inch sleeved holes should be provided between the rooms. If the MER should be offset from the satellite stack due to building design limitations, four, four-inch conduits should be provided for the riser system.

The requirements for the vertical riser system should include the following:

The MER should have vertical 4" ID minimum conduit sleeved holes to the TR above, or if the MER is offset, multiple 4" conduits should be provided to the TR above. Each TR should have 4" sleeves between them, or if the TRs are offset, multiple 4" conduits between satellite closets should be provided. An extra minimum 1-inch metallic sleeve should be provided for the vertical riser ground system.

The number of holes or conduits depends on the number of building levels. For multi-level buildings with six (6) floors or less, including the basement or ground floor, the number of sleeves or conduits between a given floor and the one above it should be six plus a minimum 1-inch conduit or sleeve for the vertical ground system. For buildings with seven or more floors, additional 4" sleeves or conduit may be required. Consult with your GTA/RCDD for a determination of the number of additional sleeves or conduit beyond the six.

Conduits in the room should extend below the ceiling and above the floor 4" with a 2" clearance from the finished wall.

Fire stop material should be installed in all sleeves installed by the Contractor.

A continuous length of properly sized insulated copper ground wire should run through all satellite closets on each floor starting from the Telecommunications Main Grounding Bus Bar (TMGBB) in the MER. The properly sized vertical ground wire should be terminated on a Telecommunications Grounding Bus Bar (TGBB) in each satellite closet. If there are more TRs on a floor, a properly sized copper ground cable should be run from the TGBB in the first TR to a TGBB located in each TR. A separate minimum 1-inch metallic conduit should be provided for pulling the ground cable to each closet.

All conduits provided for the ground wire system should be metallic.

7.0 Horizontal Pathways

7.1 Conduit Systems

The state uses two types of conduit systems. One type is called the Zoned Home Run System. The other is the Cable Tray System. The Zoned Home Run System consists of a system of TRs located to serve a floor area where the maximum allowable cable length is 250 feet. In this configuration all voice, data, and paging system conduit is "home-run" to the appropriate TR serving that zone. Depending on the size of the building and floor geography, the Zoned Home Run System should generally require more TRs than the Cable Tray System.

The Cable Tray System uses cable tray in conjunction with conduit. The cable tray should be installed in the ceiling space above the major hallways in a configuration that provides the occupants with the most efficient and productive use of communications services. The cable tray supports all communications cabling, whether data, voice, video, or paging. Radiating conduits are provided from the cable tray to each Work Area Outlet (WAO). As with the Zoned Home Run System, the total measured linear feet of cable should be limited to 250 feet.

7.2 Cable Tray

Cable trays should be installed and filled in accordance with ANSI/ANSI/TIA/EIA -569-A-7, Commercial Building Standard for Telecommunications Pathways and Spaces – Addendum 7, Cable Trays and Wire-ways

The cable tray should be industry standard, ladder type trays should consisting of two longitudinal members (side rails) with transverse members (rungs) welded to the side rails. Rungs should be spaced 6 inches on center

Each rung must be capable of supporting the maximum cable load, with a safety factor of 1.5 and a 200 pound concentrated load when tested in accordance with NEMA VE-1, section 5.4.

The following table gives dimensions of cable tray by amount of floor space to be served. Cable tray should be specified and can be 12 to 24 inches wide of aluminum or steel construction with 3” to 9" rung spacing.

Maximum allowable space to be served by one TR using the cable tray system

Floor Space to Be Served in Square Feet	Cable Tray Dimension
Up to 5,000	12"
5,001 to 20,000	18"
20,001 to 35,000 *	18"

The cable tray should be mounted above the finished ceiling in the main corridor. It is imperative that the cable tray be installed no less than 4 to 8 inches above the ceiling tile and have no less than a 24" horizontal clearance along one side and 6" above the tray. This will ensure that the cable tray is accessible.

No foreign conduit, pipes, or HVAC duct should rest on or extend through the cable tray. Supporting hangers should be attached along the cable tray sides and not within the cable tray bed. The cable tray should "tee off" if required and be run into the MER or TR. If the MER or TR wall is a firewall, the cable tray should be terminated at the wall and 4" conduit sleeves provided into the room. Under no circumstances should the number of 4" conduits penetrating the fire wall be less than two for the 12" cable tray and three for the larger cable trays.

Rooms directly adjacent to the TR or MER room can be directly served by home-run conduit, bypassing the cable tray.

Conduit should be provided as a continuous run perpendicular from the cable tray to the WAO. All cable should be enclosed in conduit or cable tray for protection.

Because the cable tray requires ceiling spaces that are accessible, cable tray should not be placed above permanent

type ceilings or above offices. Sufficient quantities of four-inch EMT conduit should extend across the inaccessible ceiling to cable trays in the accessible ceiling spaces.

7.3 Conduit

The conduit may consist of two (2) types: rigid metallic and/or electrical metallic tubing. PVC is allowed only in wet and/or corrosive environments.

7.4 Rigid Metallic Conduit

Rigid metallic conduit (RMC) should be industry standard, heavy wall steel conduit and should have galvanized finish throughout.

RMC should not be less than 1" trade size.

Rigid metallic RMC conduit installation should be made in accordance with industry standards for installation.

Running threads, split couplings and thread-less couplings should not be accepted.

Install metallic bushings at all terminations in cable trays, freestanding conduits, and within boxes, enclosures and cabinets.

During installation, cap all runs left unfinished or unattended overnight. Cap all terminations of finished runs with manufactured fittings to prevent ingress of moisture until wire and cable are pulled in.

No more than two 90 degree sweep bends or the equivalent should be permitted between junction boxes, pull boxes, cabinets, or cable access points. The sweep bend radius should not be less than 12".

7.5 Electrical Metallic Tubing (EMT)

Electrical metallic tubing should not be less than 1" trade size

All EMT conduits should be cold rolled steel tubing with zinc coating on the outside and protected on the inside with zinc enamel or equivalent corrosion-resistant coating.

EMT may be installed in dry construction in sheltered spaces, in partitions other than concrete, and in solid plaster-work. EMT should not be installed where:

- it will be exposed to view below 8’ above finished floor,
- it may be subject to severe physical damage,
- it may be subject to severe corrosive influence,
- trade size is larger than 2", or
- tubing, elbows, couplings, and fittings should be in concrete or in direct contact with the earth.

EMT couplings should be all steel, hexagonal, compression type with all joints made tight. Follow installation practices as specified for rigid conduit.

All empty conduit runs should have a nylon type pulling tape, string, or wire installed from outlet to TRs. This tape should be continuous through all junction boxes. The pulling strength should not be less than 200 pounds on either type of pulling facilities provided.

7.6 Outlet Boxes, Junction Boxes, and Pull Boxes

Except as noted, all boxes should be manufactured from galvanized industry standard gauge sheet steel.

Flush mount outlet boxes for data and voice should be a minimum size of 4-11/16" square, with a minimum depth of 2-1/8", with vertical mounted single gang plaster rings and the standard mounting height should be 18" centered above the finished floor or 6” centered above a backsplash in a countertop area. For classrooms, lecture halls, auditoriums, or designated multi-media rooms, the double gang electrical box should be equipped with a double gang plaster ring with 1" radial conduit.

Each outlet box should have 2-1” conduits and each conduit should have no more than two 90° bends between the outlet and the designated communications room or cable tray. If more than two 90 degree bends are required, a pull box should be installed and the locations of pull boxes should be shown on the drawings. The use of LB, LL, and LR fittings should not be used without approval by the GTA/RCDD. Outlets should not be looped in the same run of conduit.

Flush wall mount telephone outlets should be 4-11/16" square with a minimum depth of 2-1/8", a mounting height of 48" to the center above the finished floor, and conduit entry from the top.

Interior surface mounted devices and raceways (exposed to view) to be metal type and should be painted to match wall surface.

7.7 Sizes and Capacities of Conduits

The following table gives the nominal conduit dimensions and the maximum number of cables that may be placed in them. A pull box or one trade size larger should be specified if (a) the length is over 200 feet, (b) there are more than two 90 degree bends, or (c) there is a reverse bend in the run. If the type of communication or data system is unknown, the conduit size to be specified should be 1" minimum.

	Cable Type					
Conduit Size in Inches	**4 Pair**	**6 Pair**	**25 Pair**	**50 Pair**	**75 Pair**	**100 Pair**
1"	8	6	3	1	0	0
1¼"	16	10	3	1	1	1
1½"	20	15	4	2	1	1
2"	30	20	7	4	3	2
2½"	45	30	12	6	3	3
3"	70	40	17	7	6	6

Outside diameter equivalencies:

6 pr. ca. = 1 coax RG 58, 59, or 6 fiber optical cable.
25 pr. ca. = 1 IBM Type 1 cable
50 pr. ca. = 1 Thick wire Backbone or .500 coax cable.
100 pr. ca. = 1.750 broadband cable.

A drawing of all communications conduit, raceways, and outlets should be a part of the contract drawings and updated to as-built conditions.

7.8 In-floor Systems

In floor Systems should be installed in accordance with ANSI/ANSI/TIA/EIA -569-A-5, Commercial Building Standard for Telecommunications Pathways and Spaces – Addendum 5 – In Floor Systems

Fixed "In-floor Systems" are generally not recommended due to the inflexibility of such systems. Access floor systems provide a much better solution in computer laboratories, computer rooms and other open spaces that may be rearranged frequently. Depressed slab type Access floors will allow for level entry into a room and provide the advantages of the Access Floor System. Tiered lecture halls may be designed to use In-floor systems but should be carefully planned if utilized to insure coordination with electrical and structural disciplines. Once concrete has been poured it can be very expensive to make changes and if improperly designed and/or installed the system may become more of a liability than an asset.

During construction the in-floor systems should be sealed watertight to prevent moisture from accumulating in the conduits, boxes or raceway. Often the in-floor systems must be left exposed to the elements during construction since the floor slabs and all conduit contained within the slab are installed well before the building is "dried-in" or before a roof has been constructed.

Floor boxes should not be "daisy-chained". A minimum one-inch conduit should serve each floor box and extend to the cable tray in the hallway or Homerun to the nearest TR.

In-floor boxes should be large enough to prevent the cable-bending radius from being exceeded.

7.9 Surface Mounted Raceway

Surface mounted raceway is generally not acceptable for new installations but may be required in renovations

Surface mounted raceway should be installed and filled in accordance with ANSI/ANSI/TIA/EIA -569-A-1, Commercial Building Standard for Telecommunications Pathways and Spaces – Addendum 1 – Surface Raceways

The raceway should be sized to insure less than a 40% fill with an additional 50% spare capacity to allow for future growth.

All surface mounted raceway must be identified and labeled on the print set with the contents and the from-to locations.

All surface mounted raceway must be secured to walls with wall anchors and screws as per the raceway manufacturer's recommendations. Raceway should not be secured to walls with double-sided tape or other adhesives. Vertical sections of raceway should be continuous from above the ceiling to the outlet box location 18" AFF. Splicing of short sections of raceway is not acceptable

In some computer laboratories and other laboratories it may be advantageous to utilize surface raceway.

Metallic surface raceway should be bonded and grounded in accordance with applicable code and ANSI/ANSI/TIA/EIA – 607.

7.10 Modular Furniture Raceway/ Furniture Pathways and Spaces

When Modular type furniture is to be installed the fill recommendations of ANSI/ANSI/TIA/EIA -569-A-2, Commercial Building Standard for Telecommunications Pathways and Spaces – Addendum 2 – Furniture Pathways and Spaces should be followed

The following items should be addressed well before construction of the facility begins or before the furniture is specified

- The Pathway Fill Factor
- Furniture Pathway Capacity
- Access to the Furniture Pathway
- Furniture Pathway Bend Radius
- Power and Telecommunications Separation

8.0 Intra-building Backbone Cabling

8.1 Backbone Cabling

Backbone cables are the major service cables that interconnect various buildings on a campus, connect equipment rooms to telecommunications closets within a building, or connect one telecommunications closet to another within the same building. Backbone cables are typically large capacity (high pair count) copper cables for voice, fiber optic cable data and coaxial cable for video.

8.2 Backbone Cabling to Support Voice Systems

Voice (telephone) backbone cable will typically originate at the location of the facilities telephone system. The backbone cables will route to the various buildings on the campus, and/or the various floors of the building to distribute telephone service to the telecommunications rooms. Voice backbone cables should meet the following

requirements:

Voice backbone cables should be minimum Category 3 cables and it is recommended to have an overall metallic shield.

Voice backbone cables installed in underground conduits should be gel filled cables

The shield of all backbone cables must be bonded to the Telecommunications Main Grounding Bus bar.

Voice backbone cables should be sized to support 2-pairs per each voice station, plus 25% growth. When calculating size, voice stations should also include fax machines and dial-up modems. .

8.3 Backbone Cabling to Support Inmate and Pay Telephones

Backbone cabling, to support inmate telephone service, should meet all of the same requirements for voice backbone cables above, plus the following additional requirements:

All newly installed inmate telephone backbone cables should be separate cables (separate sheath) from all other voice and data services.

All inmate telephone backbone cables should have separate termination blocks from all other services.

All inmate cabling must have an easily accessible disconnect point to disable service.

All inmate telephone cables and termination hardware should be identified with the color yellow, to indicate auxiliary circuits.

All inmate telephone cabling must be installed in metallic conduits and properly secured to the building infrastructure.

8.4 Backbone Cabling to Support Data Systems

The standard backbone cabling to support data systems at state facilities has been 62.5/125-micron graded-index, multimode fiber optic cable. To prepare facilities for migration of networks to One Gigabit Ethernet and higher backbone speeds. The IEEE ratified 10-Gigabit Ethernet in June 2002 and due to distance limitations of 62.5/125-micron multimode fiber at the 10 Gbs speed (35 meters), 50/125-micron fiber has also been adopted in the latest revision of ANSI/ANSI/TIA/EIA 568. It is recommended that all new installations of multimode fiber optic cable utilize the 50-micron fiber optic cable to provide for a migration path to 10Gbs.

All newly installed fiber optic cable and components for LAN use must be rated and install to comply with the IEEE 802.3ae Ten Gigabit Ethernet Standard.

The minimum recommended standard fiber optic backbone should include both single mode and multimode fiber optic cable. Composite cable containing both single-mode and multimode is not recommended. It is highly recommended that separate single mode and multimode cables be installed. Using separate single mode and multimode cables helps to identify the two cable types, reducing confusion and the chance for error during installation, maintenance, and administration.

Single-mode and multimode fiber should always be terminated on separate patch panels and clearly identified with labeling and color-coding.

All strands of a fiber optic cable must be terminated with connectors and tested. The installation of "dark fiber" is not recommended.

The minimum recommended standard cable size for the inter-building fiber optic backbone is a 12-strand 50- micron multimode and 12 strand single mode to each TR from the MER. Strand count may be increased to meet specific requirements.

All newly installed fiber optic cable should be placed inside plenum innerduct. Where space is limited in existing conduit systems, innerduct may be omitted.

Both ends of all backbone fiber optic cabling should be terminated with 568SC paired connectors

Fiber optic cables should always have a minimum 15-foot service loop at the terminating ends and all splice points.

8.5 Backbone Cabling to support Video/CATV

For Video and Broadband (CATV) applications to 2 Ghz 75-ohm coaxial cable has traditionally been utilized. For CATV backbone applications this semi-rigid coaxial trunk cable may be utilized. They are available in sizes from .500in to 1.125in, in diameter. The electronics to compensate for cable loss and to equalize signal levels must also be provided and it is recommended that a certified CATV engineer design the system.

Multimode and single mode, fiber optic cable may also be used for CATV and Video backbone cabling. If it is desired to use fiber optic cable in lieu of the 75-ohm coaxial cable then additional capacity/more strands of fiber should be provided over and above the recommended minimum of 12 multimode and 12 single mode strands to each TR from the MER.

8.6 Backbone Cabling to Support Other Low Voltage Systems

During planning for backbone cable installations, consideration should be given to migration of other low voltage systems such as CATV, CCTV, fire alarm systems, and facility control and monitoring systems to the common structured cabling system.

9.0 Horizontal Cabling

9.1 General

Horizontal cabling should be installed in accordance with ANSI/ANSI/TIA/EIA 568. One exception to the standard recommended by the state is to limit the horizontal distance of all cabling to 250 feet in order to provide an additional margin of reliability over and above the 295' specified by ANSI/ANSI/TIA/EIA 568.

9.2 Horizontal Distribution Cabling

Horizontal distribution cable is the cable that extends from the telecommunications closet to the work-area. The standard configuration for the state is to route a minimum of one 4-pair cable for voice and one 4-pair cable for data to each work-area. In all new installations, Category 5e or Category 6 UTP cable should be used for both voice and data. Where additions are made to existing installations, Category 3 UTP cable may be used for voice and Category 5e or Category 6 UTP for data, to remain consistent with the existing installation. The configuration may be adjusted to meet individual needs, provided that any adjustments comply with all codes, standards, and requirements of this manual and the manufacturer's recommendations. For example, a wall mounted telephone location need only have one voice cable. Or, a particular work-area may require one data and two voice cables to support a computer, telephone, and fax machine. Splitting cable pairs from one cable to two or more outlets to avoid adding an additional 4-pair cable is not allowed – no exceptions. The addition of spare Information Outlet jacks at any given work-area, or

the addition of spare Information Outlet locations on several walls of a room, is encouraged within the limitations of the project budget.

9.3 Cable to Support Voice Systems in New Installations

Horizontal distribution cable to support voice services in new installations or major renovations and remodeling should be plenum rated 4-pair Category 5e or Category 6 cable as is used for data service.

9.4 Additions of Cable to Support Voice Systems in Existing Installations

Additions of horizontal distribution cable to support voice services in existing installations should be plenum rated 4-pair Category 3 cable, or better performance.

9.5 Support for Wall Mounted Telephones, Pay Telephones or other Specialty Phones

Horizontal distribution cable to support wall-mounted/specialty telephones should be Category 3 (minimum) cable. These cables should be no less than 4-pair to each telephone. The TR end of telephone cables should be terminated to separate 110-blocks. The work-area (telephone) end of specialty phone cables should not be terminated. The telephone service provider will terminate the cables directly to the telephone sets.

9.6 Horizontal Cable to Support Data Systems

All horizontal distribution copper cable and components for LAN used in new or refurbished state buildings, and state-owned facilities, and state leased facilities must be rated and installed to support the IEEE 802.3ab 1000Base-T Gigabit Ethernet standard. Additionally, the Agency's Facilities Coordinator may specify installation of copper cable and components to support Gigabit Ethernet at state buildings that currently do not have cable capable of supporting these data speeds.

Horizontal distribution cable to support data services should be minimum plenum rated 4-pair Category 5e or Category 6 cable.

In existing buildings, where additions are made to an existing Category 5 installation, the additions should be made using no less than Category 5e cable and matching components. These cables and components must be rated and installed to support the IEEE 802.3u 100Base-TX Fast Ethernet standard.

9.7 Horizontal Fiber Optic Data Cabling

In addition to UTP horizontal data cabling two-fiber/strand 50-micron cable may be installed in accordance with ANSI/ANSI/TIA/EIA 568 B.1.

Both ends of the horizontal fiber optic data cable should be terminated with Small Form Factor/MTRJ type connectors.

9.8 Horizontal cabling to support Video/CATV

Horizontal Video/CATV cable should be RG-6 quad shield 75-ohm coaxial cable.

All cable should be run within conduit.

Each outlet should be home run to the nearest TR

9.9 Cabling to Support Other Low Voltage Systems

During planning for horizontal cable installations, consideration should be given to migration of other low voltage systems such as CATV, CCTV, fire alarm systems, and building management systems to the common structured cabling system.

9.10 Removal of Abandoned cables

Article 800 of the 2002 edition of the National Electrical Code states that "Accessible portions of abandoned cables shall not be permitted remain". Therefore in retrofit or renovation scenarios all cable that is not to be reused must be removed.

10.0 Work Area Outlet Configurations

Typically the recommended minimum standard Work Area Outlet (WAO) should include two cables to each location, one for voice and one for data. Locations that will never require data connections should have a minimum of one voice cable but may need additional voice cables for fax machines or other plain old telephone service (POTS).

Some locations may only require data and drawings should be specific when indicating voice and data cables required at each location

It is recommended that WAOs be provided in the following locations as indicated

Additional WAOs may be required depending upon the size or special needs of room.

Recommended configurations are as follows:

Executive Office - Dean/Director	Two standard WAO installed on opposite walls One WAO should include a coax connection.
Faculty/Staff Office	Two standard WAO to be installed on opposite walls
Clerical Staff Graduate Student Offices	One standard WAO to be provided for each desk or workspace
Receptionist Areas	Two voice and one data connection
Hospital Floor Nurse Station	Two standard WAO to be installed on opposite walls
Doctor's Office	Two standard WAO to be installed on opposite walls
Hospital Patient Rooms	Per EMR Requirements
Hospital Examination Room	Per EMR Requirements
Hospital Operating Rooms	Per EMR Requirements
Clinical Laboratories	Two standard WAO to be installed on opposite walls
Wet Laboratories	One voice connection per location

Teaching Laboratory	Two standard WAO to be installed on opposite walls
Conference Room	Two standard WAO to be installed on opposite walls
	One WAO should include a video connection
Lounges/Break Rooms	A minimum of one WAO plus a video connection
Computer Labs	A minimum of one WAO containing two data connections for each computer
	A minimum of one WAO containing a video connection.
	One standard wall phone placed near the door.
Standard Classroom	One standard wall mounted phone placed near the door.
	A minimum of one WAO with a video connection
Hi-Tech Classrooms	One standard WAO for a wall phone to be placed near the door or the teaching station.
	Conduit for cameras at the front and rear of the room.
	Where applicable, one WAO containing two data connections placed so there is one data connection for every seat.
	One WAO containing two data and one video connection located at the teaching station for the classroom computer and A/V Systems.
	One standard WAO to be located near an electrical outlet in the knee well or other easily accessible location on the teaching station for the use of a laptop.
	One 2-strand multimode fiber optic cable should be terminated in the cabinet of the teaching station with an MTRJ connector, home run to the nearest building TR.
	Where there is a rear projection booth in the classroom, one wall phone as well as one WAO with voice, data and video connections.
	Where there are ceiling mounted projectors or TVs, one WAO for a coax connection should be mounted in the suspended ceiling near the location for the TV or projector. WAO should never be located above the suspended ceiling to comply with NEC
Campus Emergency Phones	One voice connection per location

Ride Phones	One voice connection per location
Area of Refuge Phones (Hotel/Motel Rooms)	One voice connection per location
Pay Phones	One voice connection per phone and follow ADA guidelines
Elevator Phones	One voice connection per location.
Emergency Phones	One voice connection per location
Intercom Phones	One voice connection per location.
Access Phones	One voice connection per location
Smart Card	Two data connections per location
Monitoring Systems	One standard WAO per location
Residence Hall/Apartment Rooms	Two standard WAO to be installed on opposite walls. One WAO should include a coax connection outlet served by an addressable interdiction port
Wireless LAN Access Point	One data connection per location
Wireless LAN Antenna	One data connection
Other Systems	A minimum of one standard WAO to be installed at the location of any equipment requiring a telephone or data network connection. Arrange with the State in advance for any services that are required at this location for activation of building systems including Fire Alarm, Security and EMS systems

11.0 Grounding and Bonding

11.1 Grounding, Bonding, and Electrical Protection

The National Electrical Code (NEC) provides grounding, bonding, and electrical protection requirements to ensure life safety. Modern telecommunications systems require an effective grounding infrastructure to insure optimum performance of the wide variety of electronic information transport systems that may be used throughout the life of a building. The grounding and bonding requirements of ANSI/ANSI/TIA/EIA-607 are intended to work in concert with the cabling topology specified in ANSI/ANSI/TIA/EIA-568, and installed in pathways and spaces as specified in ANSI/ANSI/TIA/EIA-569. The requirements of these standards, and of this manual, are in addition to the requirements of the NEC.

11.2 Discussion on Grounding

There are two distinct and unique categories in the broad area called grounding. One is earth grounding. The purpose of an earth grounding system is essentially threefold: (1) To guard against the adverse effects of lightning, (2) To assist in the reduction of static, and (3) To bring a zero-voltage reference to system components in order that

logic circuits can communicate from a known reference.

The other category of grounding is known as equipment grounding. The purpose of equipment grounding is also threefold: (1) to maintain "zero volts" on all metal enclosures under normal operating conditions. This provides protection from shock or electrocution to personnel in contact with the enclosure. This is the safety aspect. (2) To provide an intentional path of high current carrying capacity and low impedance to carry fault current under ground fault conditions; and (3) To establish a zero voltage reference for the reliable operation of sensitive electronic equipment.

Electrical wiring and grounding defects are the source of 90% of all electronic equipment failures. Many telecommunications system installers and contractors have found that checking for and repairing grounding problems can solve many system problems, especially intermittent problems. As electrical connections age, they loosen, corrode and become subject to thermal stress that can increase the impedance of the ground path or increase the resistance of the connection to earth.

Before installing power-conditioning equipment such as voltage regulators or surge protectors, you should test for and correct any problems with the telecommunications or electrical grounding system.

11.3 Requirements for Telecommunications Grounding, Bonding, and Electrical Protection

All telecommunications grounding, bonding, and electrical protection at state facilities should comply with the requirement of the NEC, ANSI/ANSI/TIA/EIA-607, and the additional requirements stated herein.

11.4 Telecommunications Main Grounding Busbar (TMGB)

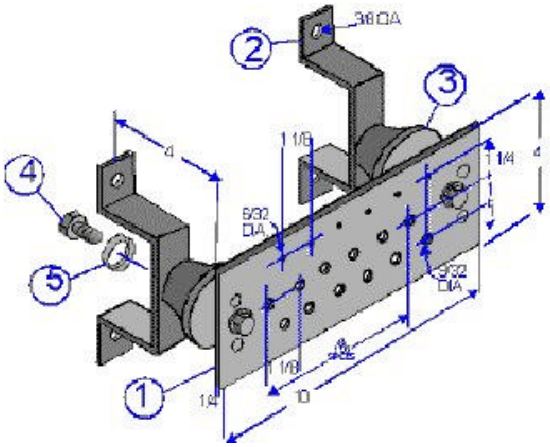
A TMGB should be installed at an accessible and convenient location in each Entrance Facility. A TGB must be installed in the Telecommunications Main Equipment Room, and Telecommunications Room.

The Telecommunications Main Grounding Busbar (TMGB) should be a pre-drilled copper Busbar with standard NEMA bolt hole sizing and spacing. The Busbar should be ¼-inch thick x 4-inch wide, with length sized to accommodate ground connection of all telecommunications racks, equipment, and shielded cables in the room, plus provision for 30% growth.

11.5 Telecommunications Grounding Busbar (TGB)

The Telecommunications Grounding Busbar (TGB) should be a pre-drilled copper Busbar with standard NEMA bolt hole sizing and spacing. The Busbar should be ¼-inch thick x 2-inch wide, with length sized to accommodate ground connection of all telecommunications racks, equipment, and shielded cables in the room, plus provision for 30% growth.

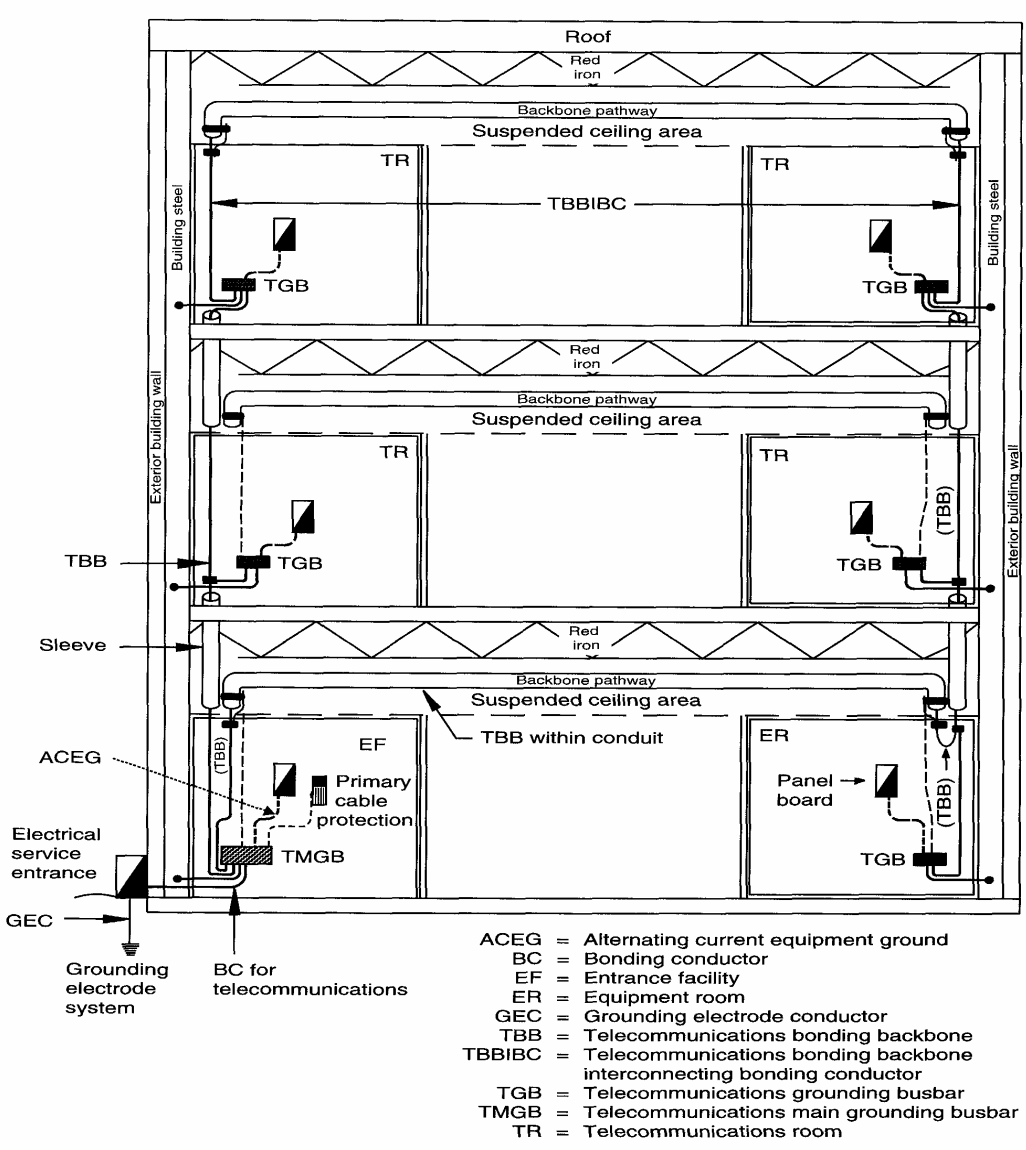
Typical Telecommunications Grounding Busbar (TGB)



The TMGB must be bonded to the building main electrical service-grounding electrode. No other grounding point for the TMGB should be allowed. The TMGB should not be bonded independently to any water pipe, structural steel, electrical conduit, or anything else other than the building main electrical service-grounding electrode. To do so will cause a difference in ground potential between the telecommunications ground and the electrical service equipment ground; this is likely to result in interference or data errors.

Where there are multiple Equipment Rooms and/or Telecommunications Closets in a building, each room or closet should be equipped with a Telecommunications Grounding Busbar (TGB). All TGBs in the building should be bonded together, and to the TMGB, with#6 AWG stranded copper cable with green colored insulation. The #6 AWG cable should form the Telecommunications Bonding Backbone (TBB).

Diagram of Telecommunications Grounding Infrastructure



Source: BICSI Telecommunications Distribution Methods Manual, 9th edition

11.6 Grounding and Bonding of Backbone Cables

All OSP copper backbone cables should have the metallic cable shields bonded to the ground lug of the primary protector block at the entrance to each building.

Any OSP, fiber optic cables that contain metallic shielding or metallic strength members, must have those metallic components bonded to the TMGB at each end of the cable.

Any inside plant copper or fiber optic backbone cables that contain metallic shielding should have the shields bonded to the TMGB at each end.

Where any splices are made to backbone cables, the metallic shields of those cables must be bonded together to maintain shield continuity.

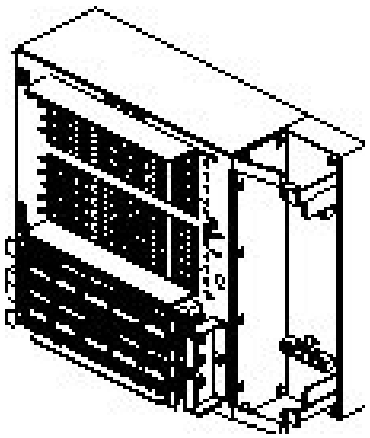
11.7 Primary Protectors

Each end of all OSP copper backbone cables should be terminated in a primary protector block. All pairs of all backbone cables should be terminated on the protector block(s).

The grounding lug of all protector blocks should be bonded to the TMGB.

Each protector block must have a protector unit (fuse) plugged into all protector unit sockets. Protector units are sold separately from the protector block.

Typical 188-type Primary Protector



1.8 Equipment Racks, Equipment Cabinets, Cable Trays and Cable Ladder Rack

All equipment racks, equipment cabinets, cable ladder racks, cable trays, and all exposed non-current carrying metal parts of telecommunications and information technology equipment should be bonded to the TMGB or TGB.

For cable ladder racks or trays, each section must be bonded together. This can be accomplished in one of three ways:

Remove any paint down to bear metal at the point where the rack section interconnection hardware is mounted. Bond the rack assembly to the TMGB with a #6 AWG ground wire.

Bond all rack sections together using braided metal bonding straps or #6 AWG ground wires. The straps or ground

wire must be attached with bolts through holes drilled in the cable rack sections. The bolts must contact bear metal on the rack sections. Bond the rack assembly to the TMGB with a #6 AWG ground wire.
Bond all rack sections to a #6 AWG ground cable run throughout the entire length of rack or tray. The ground cable must then be bonded to the TMGB.

12.0 Administration and Labeling

Administration of the telecommunications infrastructure includes documentation of cables, termination hardware, patching and cross-connection facilities, conduits, other cable pathways, telecommunications closets, and other telecommunications spaces. ANSI/ANSI/TIA/EIA-606, the Administration Standard for the Telecommunications Infrastructure of Commercial Buildings is the industry standard for administering and documenting the telecommunications infrastructure. The purpose of the standard is to provide a uniform administration scheme that is independent of applications, which may change several times throughout the life of a building. This standard establishes guidelines for owners, end users, manufacturers, installers, and facilities administrators involved in the administration of the telecommunications infrastructure.

The administration system is built upon "identifiers" and "records". The system is used to document the existing infrastructure, and to manage and administer adds, moves, and changes to the telecommunications infrastructure and telecommunications systems. The size and comp lexity of the infrastructure at a facility will dictate the level of detail required in the administration system.

All state facilities should apply and maintain a system for documenting and administering the telecommunications infrastructure. The administration system should include cable records, and equipment records for all information technology systems (voice, data, and video). The administration system should follow the ANSI/ANSI/TIA/EIA-606 standard.

12.1 Identifiers

The "identifier" is the unique name or description assigned to a telecommunications infrastructure component. Infrastructure components include, but are not limited to, cables, cable pairs or strands, conduits, Work Area Outlet (WAO) jacks, etc. Prior thought and planning is required when assigning the identifiers to components.

In a small installation, identification is usually limited to assigning unique numbers to WAO jacks, and identifying the corresponding location on the patch panel or termination block in the telecommunications closet. The most common identifiers would show a voice jack as "V-1" and a data jack as "D-1". In new construction where both voice and data jacks are Category 5E, the jacks would not indicate voice or data, but should be sequentially numbered as any jack could be used for either voice or data.

In larger installations, more elaborate identifiers may be needed to clearly identify the component. For example, a telecommunications closet may contain several patch panels serving several different floors or areas. The patch panels could be identified individually by floor or area, or could have all ports numbered sequentially.

For example, a telecommunications closet with two 48-port patch panels could be numbered in any of the following ways:

Patch Panel "A" with ports numbered DA-01 through DA-48, and Patch Panel "B" with ports numbered DB-01 through DB-48.

The first patch panel numbered D-01 through D-48, and the second patch panel numbered D-25 through D48.

The first patch panel serves the 1st floor, and is numbered D1-01 through D1-48, the second patch panel serves the 2nd floor, and is numbered D2-01 through D2-48.

When selecting the format for the identifier, consideration should be given to the following factors:

The format should be consistent throughout the facility.

The format should accommodate manageable growth to the infrastructure. For example, in a very large facility it may not be wise to number all data ports as “D-01” through D-9999”. With several hundred data ports, this format may become inefficient.

The identifier format should be generic. For example, don’t name data ports as “IBM” and “MAC" or as “Win NT” and “Novell”. Rather, identify ports to indicate their designed usage, such as “voice” and “data”, or their performance level, such as “Cat 3” or “Cat 5”.

It is the responsibility of the telecommunications infrastructure designer to designate the format for the identifiers, make identifier assignments to all infrastructure components, and clearly show these assignments on the design drawings. It is the responsibility of the cable installer to insure that all identifiers are clearly and accurately shown on the as-built drawings.

12.2 Records

A record is a collection of information about or related to a specific element of the telecommunications infrastructure. Records must be maintained in a computer spreadsheet, or in a computer database. Paper records are encouraged, but are optional.

A cable record is prepared for each backbone cable. The record will should show the cable name, or “identifier”, and must describe the origin point and destination point of the cable. The cable record will record what services and/or connections are assigned to each cable pair or strand.

An equipment record is prepared for services distributed from a certain piece of equipment, such as a hub or router, or a system such as the telephone system PBX.

The Agency should assume this responsibility and insure that cable and equipment records are maintained for each facility within their region. This responsibility will require close coordination with the Facilities Managers and Information Technology Managers at each facility.

On the following pages are a sample cable record, and equipment record.

Sample Cable Record

Cable Identifier:	ER-TC4 (Equipment Room to Telecommunications Closet #4)
Cable Type:	12-strand multi-mode fiber optic
Un-terminated pairs/strands:	0
Damaged pairs/strands:	0
Available pairs/strands:	10

Cable Connections

Pair/Strand Number:	End 1	End 2
1	Win NT Server #1	TC4 Ethernet Hub
2	Win NT Server #1	TC4 Ethernet Hub

Comments:

Use this section to record any specific comments regarding this cable, the systems or services supported or unique conditions.

Sample Network Equipment Record

Equipment Identifier:	TC4 Hub #1
Equipment Type:	10Base-T Ethernet Hub
Equipment Location:	Telecommunications Closet #4

Connection Record

Port Number:	
1	D-01 – Kathy's IBM P120
2	D-02 – Doug’s Compaq 486
3	D-03 – Network printer HP LaserJet 4
4	D-04
5	D-05

Comments:

Use this section to record any specific comments regarding this equipment, the systems or services supported or unique conditions.

12.3 Drawings

Drawings are used to illustrate different stages of telecommunications infrastructure planning, installation, and administration.

Conceptual Drawings

Conceptual drawings are used in the planning process to illustrate the intent of the telecommunications infrastructure design.

Installation or Construction Drawings

Installation or construction drawings are the plans that show the installer how the infrastructure is to be installed. The quality of the installation can be directly impacted by the level of detail in the installation drawings and written specifications. Installation drawings for state projects should, at a minimum, show pathway locations and routing, configuration of telecommunications spaces including backboard and equipment rack configurations, and wiring details including identifier assignments.

As-built Drawings

The as-built drawings graphically document the installed telecommunications infrastructure through floor plan, elevation, and detail drawings. In many cases, these drawings will differ from the installation drawings because of changes made during construction and specific site conditions. In the as-built drawings, the identifiers for major infrastructure components must be recorded. The pathways, spaces, and wiring portions of the infrastructure each may have separate drawings if warranted by the complexity of the installation, or the scale of the drawings. As-built drawings are a vital component of the telecommunications administration system, and must be kept current as adds, moves, and changes take place. State of Georgia projects will require the installer to provide a complete and accurate set of as-built drawings. It is the responsibility of the Information Technology Manager (ITM) to insure that as-built drawings are maintained for each facility. This responsibility will require close coordination with the Facility Manager at each facility.

12.4 Pathway and Space Administration

Pathways are the conveyances for distributing the telecommunications media throughout the building or campus. These conveyances may be conduits, aerial pole lines, cable trays, telecommunications vaults, and pull-boxes. Spaces are the areas where telecommunications cable and equipment will be located. The spaces may be the Entrance Facility, Equipment Room, or Telecommunications Closets.

12.5 Pathway Identifiers

Each pathway should be assigned a unique identifier. This identifier should be recorded on all as-built drawings. The pathway identifier must also be recorded on the cable and equipment records. The pathway type, pathway fill capacity and current pathway loading should be recorded for each pathway.

Pathways should be labeled at all endpoints located in Telecommunications Rooms, Equipment Rooms, and Entrance Facilities. The label should show, as a minimum, the origin and destination of the pathway. The origin is always the point closest to the Equipment Room. All pathways entering and leaving telecommunications vaults and pull-boxes should be labeled. Partitioned pathways, such as a duct bank or a conduit with innerduct, should have a unique identifier assigned to each partition.

12.6 Space Identifiers

All telecommunications spaces should have a unique identifier assigned. In new construction, space identifiers should be assigned by the Architect or telecommunications infrastructure Designer and in most cases will be the room number. In remodeling or retrofit installations, the identifier should be assigned or coordinated by Agency personnel to be consistent with other existing identifiers. All telecommunications spaces should have the space identifier labeled at the entry to the space.

12.7 Labeling and Color Coding

To be consistent with ANSI/ANSI/TIA/EIA standards and industry practices, it is important that both labeling and color coding be applied to all telecommunications infrastructure components. Labeling with the unique identifier will identify a particular component. Proper color-coding will quickly identify how that component is used in the overall telecommunications infrastructure of the facility.

12.8 Labeling

Labels are generally of either the adhesive or insert type. All labels must be legible, resistant to defacement, and maintain adhesion to the application surface.

OSP labels should be totally waterproof, even when submerged.

All labels should be machine printed, with the exception of insert labels.

Insert labels may be hand written, although machine printed is preferred. Hand written insert labels on 110 termination blocks or patch panels may be useful where phone numbers or circuit identifiers change frequently.

Insert labels that show permanently assigned identifiers should be machine printed.

Labels applied directly to a cable should have a clear vinyl wrapping applied over the label and around the cable to permanently affix the label.

Other types of labels, such as tie-on labels, may be used. However, the label must be appropriate for the environment in which it is used, and must be used in the manner intended by the manufacturer.

12.9 Color Coding

Industry standard color-coding should be applied to all cable termination fields in Telecommunications Rooms, Equipment Rooms, and Entrance Facilities. Color-coding may also be used to identify specific cables in a pathway, or the function of specific equipment racks or equipment. The same color is always applied to both ends of any given cable. Cross-connections are generally made between termination fields of different colors. The color may be applied to the plywood backboard behind the termination block, may be the color of a plastic cover on a termination block, or may be the actual color of the insert label on a termination block or patch panel. The following color code should be used in all state facilities:

Orange – Reserved for identification of the telecommunication service demarcation point (demarc). Orange may only be used by the Telephone Company.

Green – Used to identify the termination of network connections on the customer side of the demarc.

Purple – Used to identify cables originating from common equipment, such as the telephone PBX, LAN hubs, or multiplexers.

White – Used to identify the first-level, backbone telecommunications media termination, in the building containing the main cross-connect. The main cross-connect is usually in the Equipment Room. In buildings that do not contain the main cross-connect, white may be used to identify the second-level backbone terminations.

Gray – Used to identify the second-level, backbone telecommunications media termination, in the building containing the main cross-connect.

Blue – Used to identify the termination of horizontal distribution cables routing from the Telecommunications Closet or Equipment Room to the Work-Area. Blue color
-coding is only required at the TC or ER end, not at the work-area end of the cable.

Brown – Used to identify interbuilding backbone cable terminations.

Yellow – Used to identify termination of auxiliary circuits, alarms, maintenance, security, and other miscellaneous

circuits. The color yellow will be used to identify the Inmate Telephone infrastructure.

Red – Used to identify the termination of key telephone systems.

12.10 Patch Cord Color Code

All patch cords and equipment cords used with equipment on may be color-coded to visually identify the equipment as per the Agency's standard.

13.0 Design Recommendations for Wireless Systems

This manual is not intended to address the design of Wireless LAN systems. In general Wireless LANs should be installed only as extensions or additions to hard-wired LANs and not as a replacement for cabled voice, data or video networks. When considering the installation of a wireless LAN it is recommended that proprietary systems not be utilized due to incompatibilities between manufacturers. The IEEE has issued and continues to develop a series of standards intended to expand existing local area network (LAN) capabilities by including wireless functionality. There are three working groups that address a specific type of wireless network

* The IEEE 802.11 working group is responsible for wireless LAN (WLAN) specifications. WLANs like cabled LANs, serve a group of users and their computing devices in a common space, such as an office in a commercial building.

* The IEEE 802.15 working group is responsible for wireless personal area networks (WPAN) specifications. WPANs are intended to serve the connectivity needs of a single individual, linking items such as printers, scanners and the desktop computer in one work area.

* The IEEE 802.16 working group is responsible for wireless metropolitan area networks (WMAN) specifications. WMANs are being developed to provide high-speed connections to a large number of users over a dispersed or extended area.

Specifications in the form of approved standards have been issued only by the IEEE 802.11 WLAN working group.

Allowable distances for a wireless system depend heavily upon the site where the system is to be installed. The design of the network is guided by inspections and tests performed at the site, also referred to as a site survey, site verification or environmental analysis. Both physical and environmental barriers should be identified and accommodated in the design.

The following guidelines are provided to classify and rank potential obstructions:

13.1 Level 1 – Open Environment

No obstructions exist between the potential sender and receiver

A reliable estimate for the point-to-point distance of 2.4GHz signal is a minimum of 394 ft but may be as high as 656 ft.

13.2 Level 2 – Partially Open Environment

Environment contains low-severity barriers (e.g., partitions made of wood or other synthetic materials)

A reliable estimate for the point-to-point distance of 2.4GHz signal is a minimum of 98 ft but may be as high as 164 ft.

13.4 Level 3 – Closed Environment

Environment contains moderate severity barriers (e.g., floor to ceiling walls made of brick or plaster

A reliable estimate for the point-to-point distance of 2.4GHz signal is a minimum of 50 ft but may be as high as 82 ft.

13.5 Level 4 – Obstructed Environment

Environment contains high-severity barriers (e.g., metal reinforced concrete walls, elevator shafts or machinery)

The maximum reliable estimate of point-to-point coverage distance is 33 ft with a 2.4GHz signal.

13.6 Horizontal Cabling Design Considerations for Wireless LANs

One data outlet should be provided for each access point.

The access point must be located within 250 ft of a TR.

Power for the Access Points should be obtained through the data connection.

Standard outlet boxes as provided for data outlets should be provided for access points and should be mounted flush in the suspended ceiling or 18 inches below the finished ceiling in walls. One-inch EMT should be provided from the Access point box to the cable tray or home run to the nearest TR.

It is recommended that the GTA/RCDD should be contacted before designing or installing any wireless systems. The GTA/RCDD will arrange to perform a wireless site survey for coverage and frequency considerations before determining the wireless access point locations.

C. CUSTOMER OWNED OUTSIDE PLANT (OSP) DESIGN ELEMENTS

1.0 OSP Overview

The Customer Owned OSP telecommunications infrastructure includes the backbone pathways and backbone cabling required to interconnect and provide that service for voice, data, and video between buildings on a University, College, Medical or other campus.

All Customer-Owned OSP Telecommunications infrastructure must be installed in accordance with ANSI/ANSI/TIA/EIA -758, Customer-Owned OSP Telecommunications Standard (April 1999)

This section provides the necessary information to install duct banks, manholes, service entrances to buildings, and information for the termination of cables entering buildings.

All OSP voice, data, and video cabling, conduit and maintenance hole designs should be approved in writing by the GTA/RCDD prior to installation.

1.1 Cable - General

Prior approval and coordination with the GTA/RCDD and other concerned parties is necessary when the situation requires pulling cable through a conduit occupied by other cables. All cables associated with campus telecommunications networks (telephone, data, LAN, WAN, cable television and fiber optics) should be connected and disconnected by the Agency.

Only those cables specified within this document will be installed in any communications facility. There should be no cable with voltages higher than 48 volts in communications duct banks except electrical feeders for sump pumps and lights and electrical outlets in vaults.

Lights and outlets must be installed according to the National Electrical Code requirements for wet locations and should be isolated in separate conduits.

All copper cables entering a building should be terminated on protection blocks. Gas and solid state protectors should be used.

1.2 Abandoned Cables

Whenever possible, all abandoned cable should be removed from tunnels manholes and conduit. If it is not feasible to remove abandoned cable, it should be clearly tagged at both ends as abandoned, with appropriate labeling, and should be reported to the GTA/RCDD

1.3 Cable Types Allowed

Most low voltage cabling is installed underground in duct banks. No aerial cable should be installed unless pre-approved by the GTA/RCDD, the Agency and the Architect. Information should be obtained from GTA in reference to ownership of aerial cables and poles.

2.0 Safety Issues

2.1 General

This manual does not specifically address safety issues associated with its use. It is the responsibility of the user of this manual to determine and use the applicable safety and health practices of OSHA, NEC, NESC and any other life/safety standard. The State of Georgia should not be liable with respect to any liability, loss or damage caused directly or indirectly by application of this manual.

No project is so important, nor any completion deadline so critical, to justify the non-compliance with industry codes and standards.

2.2 Trenching and Excavation

The contractor should contact the one-call locating service in the area of the construction prior to commencement of any trenching activities. College and university campuses may have utilities that the locating service will not locate. It should be the responsibility of the contractor to contact the Agency and arrange for customer-owned utilities to be located by the customer prior to commencement of any trenching. A letter stating that all utilities have been located should be obtained from the locating service and the Agency.

Any and all costs incurred for damage to any utilities should be born by the excavation contractor.

2.3 Confined Spaces

The Occupational Safety and Health Administration (OSHA) requirements CFR 1910.268 (0) address telecommunications work performed on underground lines in maintenance holes and un-vented vaults. It is the designer and the contractor responsibility to determine if any spaces requiring entry are defined as confined spaces, or as permit-required confined spaces, and to follow all related OSHA procedures.

3.0 Service Entrance Conduit

3.1 General

Conduit size quantities should be determined by the agency and the GTA/RCDD. When conduits pass through exterior concrete walls of any facility, the entrance should be watertight. Wall sleeves at service entrance points must be sized to provide a minimum of ½ inch clearance around the conduit to allow for proper sealing of the penetration.

All campus buildings should be connected to the nearest manhole or new manhole if one is to be installed.

3.2 Allowable Conduit Types

Gas pipe and water pipe should not be used for conduit under any circumstances.

Two types of conduit are accepted for underground conduit systems.

3.3 Rigid Galvanized Steel Conduit with Threaded Fittings

This conduit should be installed with reinforced concrete casing. When not encased in concrete, conduit should be painted with two coats of coal tar base paint or have an epoxy coating applied by manufacturer.

3.4 Schedule 40 PVC Conduit

This conduit should be installed with reinforced concrete casing. PVC conduit is not acceptable without reinforced concrete.

Direct burial of any conduits will not be permitted unless approved in writing by the GTA/RCDD.

3.5 Minimum Recommendations

All new facilities or major renovations should meet minimum requirements. Minimum voice, data, and video conduit required to each building should be 6 conduits. One conduit should be used for copper voice backbone cabling, with a spare conduit. One conduit will be used for fiber optic data cabling connecting into the campus fiber optic backbone and one spare conduit. All conduit used for fiber optic cabling should have (4), one-inch, corrugated, innerduct. One conduit will be used for coaxial or fiber optic video cabling and one spare conduit.

In a campus environment six (6), four-inch, Schedule 40, PVC should be installed. Two (2) of which should have four (4), one-inch, corrugated, innerduct installed for fiber optic data cabling.

For stand alone facilities, when a campus data network is not present, there should be a minimum of three (3), four-inch Schedule 40 PVC conduits provided for telephone service and three (3) four-inch Schedule 40 PVC for CATV or for other carrier service.

No more than the equivalent of two 90-degree sweeps is allowed in a conduit run, including offsets. Absolutely no "LB's" (elbows) allowed in any conduit route inside or OSP.

Some buildings may require connection to each other in addition to the service entrance conduit requirement. Buildings larger than 100,000 square feet should have two means of access to the campus underground conduit system.

All conduits and Innerduct should have foot-marked mule tape installed to facilitate installation of cabling in the future.

Schedule 40 PVC conduit should be transitioned to threaded, Rigid Galvanized Steel conduit prior to penetration of the building wall or floor slab.

4.0 Maintenance Holes, Handholes and Vaults

4.1 Maintenance Holes

Maintenance holes are concrete, steel or cast iron units provided with a removable lid that permits access via a ladder. The minimum maintenance hole, interior dimensions, should be 6' wide x 8' long x 7' high. The maximum depth of all maintenance holes should be ten (10) feet from the bottom unless otherwise approved by the GTA/RCDD.

All maintenance holes should be equipped with a frame and cover. The maintenance hole cover opening should be a minimum of 27 inches in diameter and should be cast with the word "TELEPHONE", COMMUNICATIONS" OR "FIBER OPTICS" and the maintenance hole number assigned by Agency's facility manager. Manhole covers are to have recessed handles that pull out when needed for removal or indented pick points. Double sealed manhole covers with handles should be used in areas with the potential of vandalism and/or flooding.

Telecommunications maintenance holes should not be adjacent to nor share any walls with electrical manholes.

The maximum distance between maintenance holes connected in any one run is 400 feet.

All materials used in a maintenance hole should be resistant to corrosion. All steel should be galvanized or zinc coated.

Maintenance hole racking equipment and cable supports are mandatory for all maintenance holes. All racks in maintenance holes should be galvanized or zinc coated. Maintenance holes should have pulling rings cast into the wall opposite to each conduit entrance. All metal components in the maintenance hole should be grounded

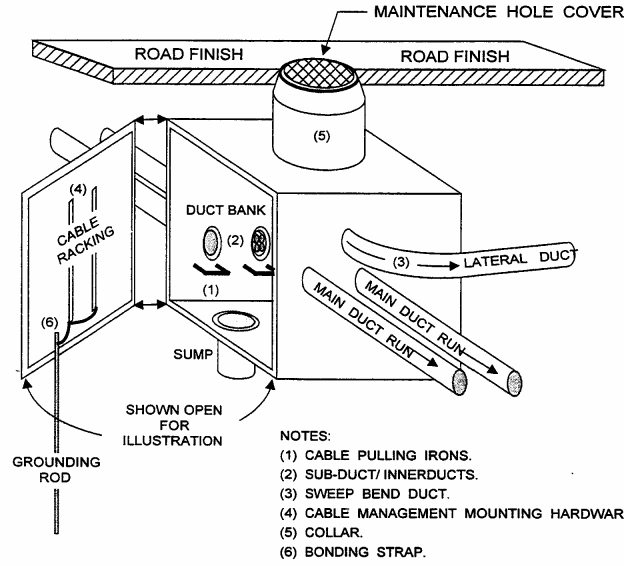
All maintenance holes should have cast-iron steps or ladders for climbing in and out.

All conduits entering a maintenance hole will be sealed from the outside of the maintenance hole prior to back filling. All conduits must be extended into the maintenance hole 4 inches and be clearly tagged. Any joints in maintenance holes are required to be watertight.

Maintenance holes should meet applicable code requirements. In the absence of applicable codes, follow the NESC.

Pre-cast maintenance holes should conform to applicable ASTM standards.

Typical Maintenance Hole



The following is a list of required items for maintenance holes:

- Identification
- Adequate working height
- Access
- Covers
- Ladders
- A sump hole
- Grounding rod
- Exposed straps required for bonding to the grounding system as required by applicable electrical codes or practice for all metallic reinforcing members
- Interlocking reinforced concrete sections with dimensions to meet AASH Interim specification 1972, Load factor design and ACI code 381-71 (USD) where applicable

4.2 Telecommunications Vaults

Telecommunications vaults should be placed in OSP conduit runs at an interval no greater than every 400-feet. Conduits between two telecommunications vaults, or between a vault and a building, should contain no more than two 90° bends or a total of 180° of bends. If additional conduit bends are required, place additional vaults as needed. Telecommunications vaults are typically constructed in pre-fabricated cast concrete, and contain a floor section, wall section, and top section. Vaults are sized based on the ultimate duct structure and equipment that will be located in the vault.

Key requirements for telecommunications vault installation include:

Telecommunications vault sections must be installed with a watertight joint sealer between the sections of the vault.

Telecommunications vaults should be equipped with a pre-cast concrete floor section. Bare earth for the floor of a vault is not allowed. The floor section must contain a sump to facilitate the use of a submersible pump for de-watering the vault.

Telecommunications vaults must be equipped with steel pulling eyes pre-cast in the walls to facilitate cable-pulling

apparatus.

Telecommunications vaults must contain cable racks for dressing and securing cables that route through the vault.

Telecommunications vaults over 5-feet deep must have permanently installed ladders.

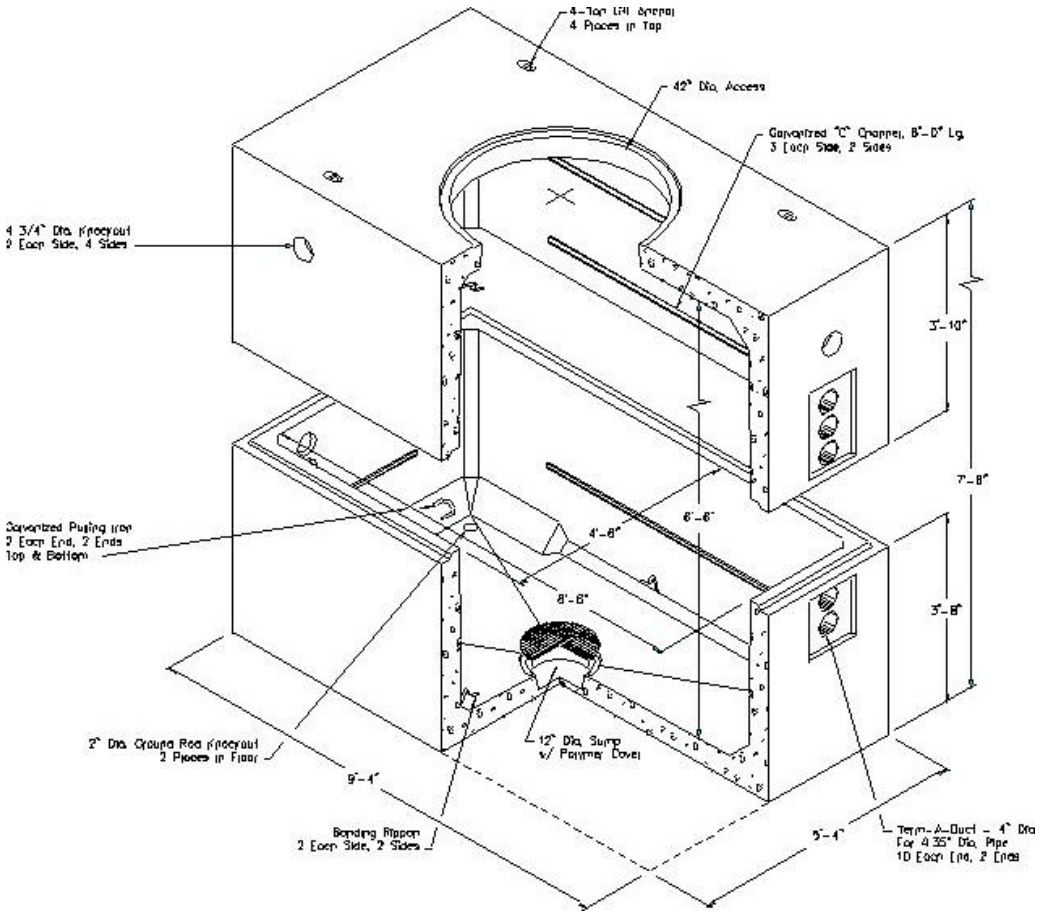
All telecommunications vaults should have a minimum of one grounding rod.

All metal hardware in the vault or handhole (racks & ladders) must be grounded to the bonding tabs pre-cast in the vault, with the bonding tabs bonded to the ground rod.

All telecommunications vaults located within secured areas must have either lockable or bolt down covers, as approved by local security personnel, to prevent unauthorized access.

The cover of all telecommunications vaults must be a minimum of 1-inch above the finished grade after all landscaping is completed. If vaults are located in paved areas, the pavement must be tapered up to the vault cover.

Typical Telecommunications Vault



4.3 Telecommunications Handholes

Handholes should be used for outside cable installation. Handholes should be provided at building entrances, both sides of road or parking lot crossings, at tie-ins to existing conduits and where multiple cable runs intersect.

Handholes should be 60"x36" and a minimum of 36" deep, with a heavy-duty cover labeled "Fiber Optics".

A handhole is similar to a miniature vault that is used solely as a pulling point to expedite the installation of cable in conduit runs over 400-feet or with more than two 90° bends. The following rules apply to the use of handholes:

A handhole should not be used if the ultimate or total requirements exceed the capacity of two 4-inch conduits, in and out.

Where more than two 4-inch conduits are used in a duct bank, telecommunications vaults must be used in lieu of handholes.

A handhole should not be utilized for splicing cables together.

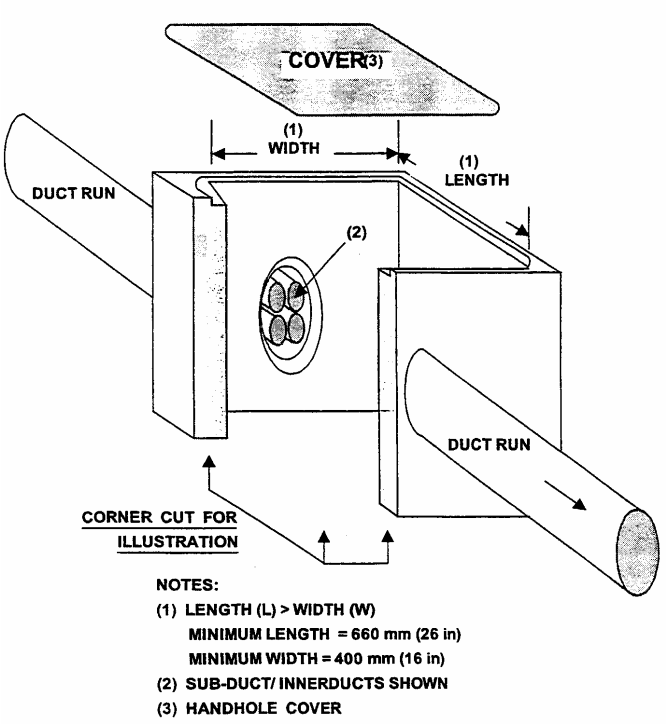
Conduit entering the handhole should be aligned on opposite walls of the handhole at the same elevation. Handholes placed inside Secured Areas must have lockable or bolt down covers, as approved by local security personnel, to prevent unauthorized access.

Handholes should be pre-cast polymer concrete type (Quasite).

Hand holes of additional depths as required ensuring minimum conduit depth is maintained throughout.

Handholes should be installed a maximum of 400' spacing to maintain proper cable pulling tension.

Typical Telecommunications Handhole



4.4 Cables and Labeling

All cables entering a manhole must loop around the manhole to allow for expansion of the cable. Looped cable should be kept a minimum of six (6) inches above the floor of the manhole.

All cables should be labeled at both ends using aluminum or stainless steel tags with the following information.

- The owner of the cable
- Cable number
- Cable type
- Pairs utilized
- Termination point.

5.0 OSP Pathways

5.1 Telecommunications Substructure, OSP

The OSP Substructure is the physical pathway used to distribute backbone cabling between buildings, and to bring the entrance cable from the service provider across state property to the Entrance Facility. Underground conduit is the preferred method of distribution between buildings on a campus.

In new construction, the OSP Substructure must be sized to accommodate all low voltage services planned for initial installation, plus a minimum of 25% growth capacity.

5.2 Underground Distribution

Underground distribution of low voltage services on state property should consist of appropriately sized conduits telecommunications vaults or handholes. Telecommunications services and other low voltage services such as fire alarm, security systems, and CATV distribution should not share the same underground distribution conduits and vaults as electrical power distribution.

It is critical that the planned substructure installation is be approved by an RCDD, and that the Agency personnel supervising are familiar with the standards and requirements contained in this manual.

5.3 Underground Conduit

Direct burial of telecommunications cable is not desired, and should only be utilized under unique circumstances on a case-by-case basis. The major cost in placing underground utilities is the labor for digging the trench. Therefore, underground telecommunications distribution to permanent facilities should always be placed in conduit to facilitate the easy installation of additional future cables.

All OSP (OSP) substructure installations should comply with ANSI/ANSI/TIA/EIA-569. Key requirements for underground conduit installation include:

OSP conduit quantity and size should be determined based on the requirements for the initial installation of cable and a realistic prediction of future expansion in the area. Always provide a minimum of 25% spare capacity.

OSP conduit quantities should be based on a maximum of 40% cable fill per conduit.

All OSP telecommunications conduit installations should use 4-inch conduits, with a minimum of one spare conduit.

All OSP telecommunications conduits should be Schedule 40 or Schedule 80 Polyvinyl Chloride (PVC) pipe. All conduit sections should be glued with PVC pipe glue to form a watertight joint. Spacers are required to maintain proper separation between multiple conduits in a run.

The PVC conduit should transition to rigid metal conduit a minimum of 10-feet from the building foundation. Rigid metal conduit should route from that point to the building Entrance Facility. The rigid metal conduit is required to compensate for the shearing effect of excavated ground settling around the building foundation, and to provide protection from any future landscaping activities near the building.

The OSP conduit system should be encased in hard-tamped sand or fine granular earth a minimum of 3-inches above and below the conduits.

The OSP conduit system should be encased in 2,500-PSI concrete when the conduit passes under roads or driveways.

All OSP conduits should be installed with a slight drain slope (0.125-inches-per-foot) to prevent the accumulation of water in the conduit.

There must be no 45° or 90° conduit bends within 10 feet of a telecommunications vault, handhole, or building.

Any bends within 10 feet of a vault, handhole or building must be sweeping bends.

All campus distribution conduits must be buried a minimum of 24-inches deep, with preferred depth of 36-inches.

Conduit placed for routing of entrance cables from the service provider to the Entrance Facility should be installed per the service provider's requirements, generally 36 to 48-inches deep. Prior consultation with the service provider is required.

All OSP conduit and duct bank runs must have an orange colored, metal detectable warning ribbon installed ½ the distance between the top of the conduit and the finished grade.

Prior to installing cables, all new or unused OSP conduits must be cleaned with a brush pulled through the conduit at least two times in the same direction. All OSP conduits must be tested with a mandrel to insure consistent inside diameter throughout the conduit run.

All cable should be installed in the lowest available conduit in a duct bank, working up as additional cables are installed.

All spare OSP conduits, and all OSP conduits not filled to capacity, should have 1/4-inch polypropylene pull ropes installed. The pull ropes must be re-pulled each time an additional cable is installed.

All OSP conduits, used and spare, should be plugged at both ends to prevent the intrusion of water, gasses, and rodents.

In new construction, fiber optic backbone cables should always be installed in fiber optic innerduct. Normally, three Innerduct can be placed in a 4-inch conduit. Where fiber optic cable is installed into existing conduits, the use of fiber optic innerduct is preferred if space is available. Innerduct is used to separate and segregate cables, and to prevent the tangling of cables in a conduit.

5.4 Aerial Distribution

Aerial distribution of telecommunications cabling at State facilities is not authorized recommended for new construction unless specific approval is granted due to unique circumstances.

Aerial distribution is undesirable because of:

- The lack of mechanical protection for the telecommunications services
- Affect of the overall aesthetics on the building or campus
- Vehicle and pedestrian overhead clearance requirements
- Storm-loading requirements
- Physical security requirements

Aerial distribution may be used to provide upgraded telecommunications services to an existing building using existing aerial distribution facilities or if unique circumstances make underground distribution undesirable. In cases where aerial distribution is to be used, RCDD approval of the design is highly suggested, and may be required by the state. The facility Superintendent, or designated representative, must validate that the use of aerial distribution presents no physical security hazard or security weakness to the facility.

5.5 Wireless and Radio System Distribution

State of Georgia facilities frequently use wireless or radio systems for communications with mobile units and personnel, both on and off of the campus. These systems typically have one or more radio antennas connected by cabling to radio transceiver equipment. In many cases, the radio equipment is interfaced into the telephone system. The OSP telecommunications substructure must provide adequate cable routing pathways between antenna locations, radio transceiver locations, and the telephone backbone cabling system.

Radio antenna transmission cables that connect the antenna to the radio transceiver contain radio frequency (RF) radiation. These cables may be routed through the common telecommunications duct bank and vault system if necessary, but should be routed in a separate conduit from other telecommunications cables. Cables containing RF radiation must be shielded cables.

Radio transceivers may interconnect to remote radio operating positions, or to the telephone system. These interconnections are typically accomplished using standard telephone cabling. These interconnection cables should be routed through the common telecommunications duct bank and vault system. Individual conduits may be shared for these interconnection cables and other telecommunications services, and available cable pairs in telephone backbone cables may be used for these interconnections, provided that the signaling is analog or digital signaling, and does not contain radio frequency radiation.

5.6 Underground Ductbanks

The layout of duct banks should be generally parallel and perpendicular to property and building lines.

All conduit and ducts must be terminated with bell ends at the manhole, facility or other termination point. A nylon pull string will be installed and tied off in each conduit.

All underground conduits and ducts, rigid or PVC, installed should be added in multiples of two.

All underground conduits, duct banks and raceways should be encased in steel reinforced, concrete (3500psi minimum).

Additional reinforcement should be used when crossing roadways.

All communications ducts should be a minimum of twelve (12) inches from power duct banks or cables. All communications ducts should also be a minimum of twenty- four (24) inches from steam pipes and condensation lines if crossing perpendicular. When communication ducts run parallel to steam lines a minimum of six- (6) foot separation is required to avoid conduction of heat. All other duct separations must comply with the National Electric Code.

Rigid steel conduit, encased in reinforced concrete, should be used in any location subject to unbalanced pressure, such as under slabs, roadways, driveways, or foundations.

All necessary precautions should be taken by the contractor during construction to prevent the lodging of dirt, plaster or trash in all conduit, tubing, fittings and boxes. All conduits in floors, concrete or below grade should be swabbed free of debris and moisture before wires are pulled.

5.7 Duct Bank Envelope

The duct envelope should be sized and placed as shown on construction documents.

The top of the duct envelope should be no less than 24 inches below finished grade.

The duct envelope should have a rectangular cross section and provide a minimum concrete thickness of three (3) inches on the top and sides of all conduits and six (6) inches at the bottom of the envelope.

Reinforcing rebar rods should be sized according to the number conduits in the duct bank envelope.

Four (4) conduits – use #4 (½") rebar

Six (6) or more conduits – use #6 (¾") rebar

A minimum of four (4) steel reinforcing rods should be installed parallel to the conduit in all duct bank envelopes. Reinforce these rods with perpendicular rods in between the spacers.

Duct spacers should be provided at a maximum of seven- (7) foot intervals. Large Ductbanks with 12 or more conduits will require spacers installed at shorter intervals. The GTA/RCDD will provide requirements prior to installation.

Where conduits enter a building or a manhole the rebar must be doweled into the structure to prevent shearing of the conduits in case of settlement.

Where trench walls are unstable or the trench width is wider than the designed envelope, the envelope should be formed as required.

Each duct run should be installed with a continuous concrete pour. Broken pours are not allowed without written exception from the GTA/RCDD. In the event of an approved broken pour the rebar will extend twenty four (24) inches beyond the end of the envelope and at all stub-outs at the end of each day's pour.

A yellow coloring agent should be added to the top three- (3) inches of concrete used for underground communications ducts. The color agent is subject to GTA/RCDD approval.

5.8 Duct bank Inspection

It is recommended that all duct runs be inspected and approved by the GTA/RCDD prior to pouring of concrete. At least twenty-four (24) hour prior notice should be given to the GTA/RCDD that a pour will be taking place. The designer should specify that failure to obtain inspection and approval in writing may result in removal of duct bank at no additional cost to the Owner.

5.9 Drainage of Duct Banks

Duct banks should be pitched to drain toward maintenance holes. All conduit, tubing, raceways, ducts and duct

banks should be installed in such manner to insure against collection of trapped condensation. Raceway runs should be arranged to be void of traps.

When conduits pass through exterior concrete walls of any facility, the entrance should be sealed gas tight. Wall sleeves at entrance points must be sized to provide a minimum of ½ inch clearance around the conduit to allow for proper sealing of the penetration.

All conduits should have watertight connections and be sloped so they drain away from the building entrance. All empty conduits are to be sealed gas tight with the proper materials to prevent water drainage or toxic gases from entering the building.

5.10 Marking Requirements

Utility markers should identify all conduit and duct bank routes. The type of marker and manufacturer should be obtained from the agency and GTA. Utility markers should conform to specific campus and customer environments.

Damages incurred to any conduit are the responsibility of the party involved. All damages should be reported immediately to the agency and GTA/RCDD.

5.11 Using Tunnels

Where conduit or ducts are installed in tunnels, they should be kept at least twenty four (24) inches from parallel runs of flues, steam pipes, hot gas pipes, hot water pipes or any other utility line which becomes hotter than 120 degrees during normal operation of the facility it serves. All conduit sections crossing steam lines should be threaded galvanized rigid steel and provided with a means of thermal insulation from the steam lines.

5.12 Road, Sidewalk, and Parking Lot Crossings

Outside cable runs requiring crossing of roadways, sidewalks and parking lots should be installed in four-inch galvanized rigid steel conduit. The Contractor should be required to bore/drill under or cut patch as required. The exact method should be approved by the GTA/RCDD. Bores should be a minimum of 48 inches under paved road surfaces.

6.0 Aerial Pathways

Aerial facilities consist of poles, support strand, cable and supporting pole hardware. Aerial cable is typically lashed to a cable support strand. An integral support strand may also support aerial cable. Aerial distribution of telecommunications cabling at state facilities is not recommended for new construction unless specific approval is granted to address unique circumstances. Aerial distribution is undesirable because of:

* Lack of mechanical protection for the telecommunications services
* Aesthetics of the building or campus
* Clearance requirements
* Storm-loading requirements
* Security Requirements.

Aerial distribution may be used to provide upgraded telecommunications services to an existing building using existing aerial distribution facilities or if unique circumstances make underground distribution undesirable such as excessive rock removal. In cases where aerial distribution is to be used, GTA approval of the design is highly suggested, and may be required by the Agency. The facility Superintendent, or designated representative, should validate, in writing that the use of aerial distribution presents no physical security hazard or security weakness to the facility.

7.0 Inter-building Copper Backbone Cabling

7.1 Copper Telephone Cables

The LVLTC should provide and install multi-pair cables as shown on the drawings and required by the specifications. The LVLTC should provide and install any and all hardware required to terminate copper telephone lines at both ends

The cable should be suitable for voice frequency use on all pairs. The cable should be a solid, annealed, copper conductor, with solid polyolefin insulation and color-coded to telephone industry standards. The insulated conductors should be twisted in 25, 50 or 100 pairs as required. The core of the cable should be filled with a waterproofing compound and wrapped with a non-hygroscopic core tape.

7.2 Telephony Feeder and Distribution Cabling

Underground copper cabling networks consists of three (3) distinct elements: feeder, distribution, and entrance cables.

Feeder cable is multi-paired, shielded cable routed between the Switch room supported by the underground conduit (or in the case of older feeder cables it may be direct buried) and pre-determined geographical serving areas of Campus. The geographical areas may consist of multiple buildings, vacant land, or both. The feeder cable is presently or eventually should be terminated in serving area interfaces.

Distribution cable originates from the serving area interface and serves buildings via their entrance cables.

The term "entrance" is used to describe the cable that is spliced into the feeder cable and routed into a building to provide telephony services to that building. Typically, this entrance cable is terminated in the building's SER.

7.3 Cable Type

Feeder, distribution and entrance copper cables should be of waterproof construction consisting of a single sheath, metallic shield(s), plastic insulated conductors, and moisture-proofing compound. All feeder and entrance cables should be 24 AWG; however, special inter-building cabling applications (non-feeder) may require 22 AWG. Cables should meet REA specifications PE-89 and/or have the Bell standard designation AFMW, that is, of ASP (aluminum steel polyethylene) construction. Bell standard designation for a 22 AWG cable is AFAW.

7.4 Color Coding

The copper conductors should be color coded to telephone industry standards. Unlike horizontal inside cables, outside cables do not have band-markings. Outside cables use solid-color identification where pair identification is dependent on the integrity of the twist of individual pairs. It is very important that the technician removes an end portion of the sheath and securely tapes the pair bundles before the rest of the cable sheath is removed for splicing.

8.0 Inter-building Coaxial Backbone Video Cabling

For Video and Broadband (CATV) applications up to 2 Ghz 75-ohm coaxial cable has traditionally been utilized. For CATV backbone applications this semi-rigid coaxial trunk cable may be utilized. They are available in sizes from .500in to 1.125in, in diameter. The electronics to compensate for cable loss and to equalize signal levels must also be provided and it is recommended that a certified CATV engineer design the system.

Multimode and single-mode fiber optic cable may also be used for CATV and Video backbone cabling. If it is desired to use fiber optic cable in lieu of the 75-ohm coaxial cable then additional capacity/more strands of fiber should be

provided over and above the recommended minimum of 12 multimode and 12 single mode strands to each TR from the MER.

9.0 Fiber Optic Backbone Cabling

9.1 General

The fiber optic cable should be provided for use in a variety of communications applications. These applications include long and short haul communications, local and wide area networks, data links, video transmission, CATV, and premises distribution.

All optical fiber provided should be of the same manufacturer and have the same optical performance regardless of the application or cable construction. All fiber optic termination, splicing and mounting hardware provided by the project should be of the same manufacturer.

9.2 Optical Fiber

This section describes the generic cable construction and performance requirements of the single mode and multimode optical fibers covered in this document.

9.3 Multimode Fiber

Core Diameter: The core diameter should be 50 microns; the diameter tolerance should be plus or minus 3 microns.

Cladding Diameter: The cladding diameter should be 125 microns; the diameter tolerance should be plus or minus 2 microns.

Attenuation: The attenuation of the multi-mode fiber should be approximately 3.5db/km or less at 850nm and 1.5db/km or less at 1300nm.

Bandwidth: the bandwidth of multi- mode fiber should be 500 MHZ-km.

9.4 Single Mode Fiber

Core Diameter: The core diameter should be 8.3 microns; the diameter tolerance should be plus or minus .5 microns.

Cladding Diameter: The cladding diameter should be 125 microns; the diameter tolerance should be plus or minus 2 microns.

Attenuation: The attenuation of the single mode fiber should be .5db/km or less at 1310nm and .5db/km or less at 1550nm.

Mode Field Diameter: The mode field diameter should be between 8 and 10 microns, with tolerance a plus or minus 10%.

Dispersion: The zero dispersion wavelengths should be 1310nm plus or minus 10nm.

9.5 OSP Cable

The fiber optic cables should be constructed to protect the glass fibers during installation and to prevent breakage once installed. This applies to both single mode and multimode fiber optic cable. The fibers should be located in the core of the cable to isolate them form crushing loads and impacting. The core should contain a filling compound to

prevent the ingress of water.

Tensile Strength

These cables should have a minimum tensile load rating of 600 pounds.

Filling Compound

The filling compound should be neutral in color, nontoxic, dermatological safe, and contain an antioxidant.

Strength Elements

The sheath strength elements should be non-metallic glass filaments

Jacketing

The cable jacket material should be high density black polyethylene. Outer jacket should be continuous, free from holes, splits, and inclusions.

Fiber Identification

Fiber optic strands should be color-coded so that each fiber can be individually identified. The colors should be blue, orange, green, slate, white, red, black, yellow, and violet. Dashed versions of these same colors should be used of cables with higher fiber counts.

All fiber optic cable should homerun to the Main Telecommunications Equipment Room, which should be the location of the data center. Designs that propose locating data centers in buildings other than the main ER must be approved by the Agency and the GTA/RCDD and must have the written authorization. There are financial implications to the state for the LAN equipment when alternative fiber optic designs are implemented. If the data center is in a location other than the main ER, an appropriately sized fiber optic cable should route from the ER to the data center. All interconnections between the data center backbone and the campus distribution fiber optic backbone cables should be in the MER.

10.0 Grounding and Bonding

Should be grounded and bonded in accordance with NEC and NESC for customer owned OSP.

11.0 Administration and Labeling

Labeling should be installed in accordance with ANSI/ANSI/TIA/EIA-606A.

PRODUCTS

General Comments

The following products are recommended by GTA to effectively provide telecommunications distribution within and between buildings. Descriptions of some products are repeated to clarify when and where the product should be utilized. Details on how to install each product are included in section III Execution of this manual. Please note that the project scope, size of the facility, design intent and other factors may affect when and where these products are used. It is the responsibility of the designer to ensure availability of the products and that space is properly provided for the products specified. All materials, equipment, hardware, and components to be used in the project must be new and free from defects in materials, composition and installed workmanship.

A. BUILDING INFRASTRUCTURE / INTRABUILDING PRODUCTS

1.0 Service Entrance Components

1.1 Plywood Backboards

Plywood backboards should be 3/4-inch with a Class AC surface.

Minimum backboard size should be 4' X 8' x ¾"

All sides of each backboard should be painted with two coats of white fire retardant paint prior to installation.

If the local authority having jurisdiction of fire code requires fire-rated plywood, then UL listed fire retardant plywood should be utilized and painted with white fire retardant paint prior to installation.

A fire retardant paint additive may be used and the associated documentation should be applied to the painted backboard as proof of usage.

1.2 Ladder Rack/Cable Runway

Provide ladder rack as shown on drawings for cable support.

Include connecting and all other support hardware for a complete installation including but not limited to equipment rack to runway mounting plates, wall angle support brackets, butt splice swivels, junction splice connections and grounding kits.

Ladder rack should be tubular side bar type nominally 3/8" thick by 1 1/2" high (minimum) with ½" x 1" welded rungs spaced 9" on center.

Finish should be powder coated, black.

1.3 Customer Owned Underground Copper Backbone Cables

Should be size indicated on the drawings.

Should consist of a core of 24 AWG solid annealed copper conductors, color coded in accordance with telephone industry standards.

Cable should be suitable, listed and marked for use in a duct application.

Manufacturer's cable code, pair size, manufacturing plant location, month and year of manufacture should be marked

on cable every two feet.

1.4 Customer Owned Aerial Copper Backbone Cables

Aerial Copper cable installations in general are not recommended by GTA but may be unavoidable in some instances. GTA should be contacted prior to the design or installation of any aerial cable.

1.5 Copper Backbone Cable Splice Cases

Closure should consist of a split Aluminum or PVC sleeves as indicated on the "T" drawings.

Minimum inside diameter should be 5" (127mm).

Minimum inside length should be 26" (660mm).

Actual sizes should be indicated on the drawings. Otherwise, closure to be sized to accommodate the maximum number of cable pairs to be spliced and the type of connector to be used for splicing.

Closure should be flame retardant.

Closure should be re-enterable.

When assembled with properly sized end caps, bushing, plugs and clamps, the closure should be air and water tight.

Splice Closure End Caps

End caps should be sized precisely to fit the diameter of the tip cables entering the closure.

Number of openings in the multiple end caps should be determined by dividing the number pairs in the feed cable by 100 and doubling that number. (i.e. 1200 pair cable would have 24 openings for tip cables.

Collared Cap opening can be up to 6.35mm (1/4") larger than the feed cable diameter.

Actual end cap to be provided should be based on the diameter of the feed cable to be spliced.

Plugs

Use tapered or collared plugs as required to fill extra opening in end caps.

Seal if inside diameter of hole is less than 6.35mm (.25").

Bushings

Use rubber or variable bushings as required reducing standard opening in end caps to accommodate custom diameters.

Seal if inside diameter of hole is less than 6.35mm (.25").

Lubricants

Lubricant should evaporate and should not damage closure elements in any way.

Sealing Kits

Kit should consist of a urethane adhesive designed for sealing split vault sleeves and split end caps and be re-enterable.

Clamps

Provide Sleeve and Collared clamps as required to complete work.

The Designer should require the LVLTC to adhere to all manufacturer installation guidelines.

Bonding Harnesses

Harnesses should be used to ground the shields of the spliced cables.

Bonding harness should be 14 AWG and sized according to closure.

The Architect should require the LVLTC to adhere to all manufacturer installation guidelines.

Splicing Modules

All splicing modules should have an integrated encapsulate in all environments (ISP and OSP).

Crimping process should strip the installation from the wire and trim the excess wire.

The module should create a gas tight connection.

All modules should have test entry ports on the front side of the module.

Straight splicing modules should have a yellow cover and body top and the base and body bottom should be dark gold.

Pluggable /Bridge splicing modules should have a transparent cover, the body top and bottom should be blue and the insulator should be red.

Splicing Tapes

Should be an all-weather vinyl plastic material

Should resist: Water, Acids and Alkalis

Should be flame retardant

Should not be affected by sunlight

Should release smoothly in zero weather and not ooze adhesive in hot climates.

Bonding Connectors

Should consist of a base and upper member, two securing nuts and a plastic shoe to aid connector installation and protect the conductors.

Base and upper members should be made of tin plated tempered brass, slightly curved so as to exert a continuous spring form on sheath and shield after clamping.

Grounding Braid

Should be a flat tin plated copper braid conductor

Should have eyelets at regular intervals

Eyelets should fit shield connector studs up to 6 mm (1/4") in diameter.

1.6 Copper Backbone Primary Cable Protection

Entrance Facility Terminals

Entrance Facility terminals should protect a minimum of 100 lines/ (pairs)

Dimensions should be 4.0"W x 2.0' H x 3.95" D

The input stub (tip) cable should be 26AWG shielded cable.

The input stub should serve as internal fuse link.

Input stub should be equipped with a heavy-duty strain relief and encapsulated cable connector.

Output stub cable should be 24 AWG shield cable.

Should be wall or frame mountable

Should accommodate industry standard 5 pin protection modules

Plastic components should meet or exceed specifications set for in UL 497.

Surge Protection Modules

Should be 5 pin, 3 element gas type protection modules

Module should provide true balanced operation.
Over voltage on either side should cause the entire tube to ionize to provide a simultaneous path to ground for both sides of the circuit.

Should be UL 497 listed.

Ground pin should be tin.

Tip and Ring pins should be gold alloy.

The module color should be black.

The module color should be green for spare pair modules.

The nominal DC Breakdown should be 350V @ 100V/µsec.

The impulse breakdown voltage should be 700A @ 100V/µsec and 150A @1KV/µsec.

The DC holding current should be 135V for <150ms.

The Surge life (min. operations) should be as follows:

@ 10A, 10 x 1000µsec	>3000
@ 100A, 10 x 1000µsec	>300
@ 10kA, 8 x 20µsec	>10
@ 20kA, 8 x 20µsec	>1
@ 65Arms, 11 cycles, 130A total	>1
@ 10Arms, 1sec, 20 A total	>10

The capacitance should be <1pf for 1 Vrms @ 1Khz, 50 DCV.

The insulation Resistance should be >100M ohms @ 50 VDC.
The fail safe operation should be as follows:

@ 1.0 A	<50 sec
@ 5.0 A	<15 sec
@ 20 A	<10 sec
@ 60 A	<3 sec

The current limiters should be as follows:

Hold current (ma) @ 20 C = 145

R min / max ohms = 3 / 6.

1.7 Optical Fiber Transition/Splice Cabinets

Wall mounted splice cases may be utilized in lieu of splice cabinets

All cabinets should provide support for fusion splice trays and contain cable management for supporting and routing the fiber.

The wall mount splice cabinet should:

Be available to support 12 strand fiber splice trays.

Have the ability to mount the cable clamp on the interior of the panel

Provide configurations and densities as called for on the “T” drawings.

1.8 Copper Cable Termination Blocks

The connecting hardware block should support Category 5e or Category 6 applications and facilitate cross-connection and/or inter-connection using either approved cross-connect wire or patch cords.

Should be 110 type Insulation Displacement Connector (IDC) blocks.

Be UL -Verified

Be ANSI/ANSI/TIA/EIA-568 B.1 Category 5e or Category 6 compliant.

Be made of flame-retardant thermoplastic.

Blocks should include means to identify cables/services per ANSI/ANSI/TIA/EIA-606A.

Have clear label holders with the appropriate colored inserts available for the wiring blocks.

The insert labels provided with the product should contain vertical lines spaced on the basis of circuit size (3, 4 or 5 pair) and should not interfere with running, tracing or removing jumper wire/patch cords. Label holders must be capable of mounting in the under portion of the wiring block.

Have connecting blocks used for either the termination of cross-connect (jumper) wire or patch cords. All connecting blocks should have color-coded tip and ring designation markers and be of single piece construction.

Support wire sizes: Solid or 7-strand 22-26 AWG.

1.9 Grounding and Bonding Apparatus

Telecommunications Main Grounding Busbar (TMGB)

Provide a bond with a minimum of a # 6 AWG, green insulated ground wire from the TMGB to the main electrical service building ground.

Label grounding and bonding hardware and connections per ANSI/ANSI/TIA/EIA 606A.

The ground bar assembly is to be constructed with following materials (See drawing details for additional information):

Copper Ground Bar (1/4" x 4" x 23")

Provide with insulators and a support bracket for isolation.

Provide lugs for each bonding conductor (BC) and the telecommunications bonding backbone (TBB)

Ground Lugs

Hardware (bolts) should be silicone bronze and the copper alloy lug should be sized for connecting to the TMGB with the BC and TBB.

Rack Mounted Equipment Ground Bar

3/16" x ¾" x 18 5/16" for attachment to 19" mounting rails of equipment racks and cabinets

Splice plate for attachment to multiple racks

#6-32 silicon bronze screws, ground lugs and other mounting hardware

2.0 MAIN EQUIPMENT ROOM COMPONENTS

2.1 Plywood Backboards

Plywood backboards should be 3/4-inch with a Class AC surface.

Minimum backboard size should be 4' X 8' x ¾”

All sides of each backboard should be painted with two coats of white fire retardant paint prior to installation.

If the local authority having jurisdiction of fire code requires fire-rated plywood, then UL listed fire retardant plywood should be utilized and painted with white fire retardant paint prior to installation.

A fire retardant paint additive may be used and the associated documentation should be applied to the painted backboard as proof of usage.

2.2 Ladder Rack/Cable Runway

Provide ladder rack as shown on drawings for cable support.

Include connecting and all other support hardware for a complete installation including but not limited to equipment rack to runway mounting plates, wall angle support brackets, butt splice swivels, junction splice connections and grounding kits.

Ladder rack should be tubular side bar type nominally 3/8" thick by 1 1/2” high (minimum) with ½” x 1” welded rungs spaced 9” on center.

Finish should be powder coated, black.

2.3 Equipment Racks

Equipment racks should meet the following physical specifications and should be installed as shown on the drawings:

Should be manufactured to house 19” wide equipment and be 84” in height

Should have a universal junction hole pattern

Should have #12-24 panel mounting holes

Equipment mounting hole patterns should conform to EIA-310-D

Racks should be capable of supporting a maximum load of 600 Lbs.

Constructed of 6061-T6 aluminum alloy

Finished with flat black powder-coat paint

CABLE MANAGEMENT FOR EQUIPMENT RACKS

Cable management units should be black metal.

Vertical cable management panels should have front and rear channels.

Vertical cable management panels should have removable front and back covers.

A horizontal manager should be provided at the top of each rack, with a minimum height of 2 rack units each.

Horizontal cable management panels should have front and rear channels.

A horizontal manager should be provided above and below each termination patch panel, with a minimum height of 2 rack units.

2.4 Grounding and Bonding Apparatus

Telecommunications Grounding Busbar (TGB)

Provide a bond with a minimum of a # 6 AWG, green insulated ground wire from the TGB to the main electrical service building ground.

Label grounding and bonding hardware and connections per ANSI/ ANSI/TIA/EIA 606A.

Ground Bar Assembly to be constructed with following materials (See "T" drawing details for additional information):

Copper Ground Bar (1/4" x 4" x 13.5")

Provide insulators and a support bracket for isolation.

Provide lugs for each bonding conductor (BC) and the telecommunications bonding backbone (TBB)

Lugs

Hardware (bolts) should be silicone bronze and the copper alloy lug should be sized for connecting to the TMGB with the BC and TBB.

Rack Mounted Equipment Ground Bar

3/16" x ¾" x 18 5/16" for attachment to 19" mounting rails of equipment racks and cabinets

Splice plate for attachment to multiple racks

#6-32 silicon bronze screws, ground lugs and other mo unting hardware

3.0 MAIN COMPUTER ROOM COMPONENTS

3.1 Plywood backboards

Plywood backboards should be 3/4-inch with a Class AC surface.

Minimum backboard size should be 4' X 8' x ¾"

All sides of each backboard should be painted with two coats of white fire retardant paint prior to installation.

If the local authority having jurisdiction of fire code requires fire-rated plywood, then UL listed fire retardant plywood should be utilized and painted with white fire retardant paint prior to installation.

A fire retardant paint additive may be used and the associated documentation should be applied to the painted backboard as proof of usage.

3.2 Ladder Rack/Cable Runway

Provide ladder rack as shown on drawings for cable support.

Include connecting and all other support hardware for a complete installation including but not limited to equipment rack to runway mounting plates, wall angle support brackets, butt splice swivels, junction splice connections and grounding kits.

Ladder rack should be tubular side bar type nominally 3/8" thick by 1 1/2" high (minimum) with ½" x 1" welded rungs spaced 9" on center.

Finish should be powder coated, black.

3.3 Equipment Racks

Equipment racks should meet the following physical specifications and should be installed as shown on the drawings:

Should be manufactured to house 19" wide equipment and be 84" in height

Should have a universal junction hole pattern

Should have #12-24 panel mounting holes

Equipment mounting-hole patterns should conform to EIA-310-D

Racks should be capable of supporting a maximum a 600 Lb load.

Constructed of 6061-T6 aluminum alloy

Finished with flat black powder-coat paint

Cable Management for Equipment Racks

Cable management units should be black metal.

Vertical cable management panels should have front and rear channels.

Vertical cable management panels should have removable front and back covers.

Horizontal cable management panels should have front and rear channels.

A horizontal manager should be provided at the top of each rack, with a minimum height of 2 rack units each.

A horizontal manager should be provided above and below each termination patch panel, with a minimum height of 2

rack units.

3.4 Equipment Cabinets

Equipment cabinets should be used to house equipment and not cabling terminations. Cooling fans should be provided and sized for each cabinet per electronic equipment manufacturer's and the equipment cabinet manufacturer's recommendations.

It is recommended that equipment cabinets not be used unless a raised access floor with forced air cooling is provided to ventilate the cabinets.

Equipment cabinets should meet the following specifications:

16 gauge welded steel construction

Static weight Capacity: 800 Lbs.

Exterior Dimensions: 85" x 27"x 31.75"

19" mounting rails tapped 10-32, EIA-310-D, Universal Hole Pattern, 45 Rack Units

Lockable, 16 Gauge Steel Front Window Door with Plexi-glass window

Lockable, 16 Gauge Steel, Vented rear Door

Removable, 16 Gauge Steel, Vented Side Covers

Power: 19" power Strip

Adjustable Leveling feet

#10-32 x 5/8" screws for mounting equipment (Quantity as provided by the manufacturer, typically 20)

Top mounted 400 CFM Cooling Fan Unit

19" Equipment Grounding Bar (As per manufacturer's recommendations to comply with NEC)

16 Gauge Steel, Adjustable, Fixed Shelves (Quantity to determined and specified by the Agency for each cabinet)

Integrated Vertical Cable Management

One 3.75" horizontal wire management panels above and below each piece of equipment (Quantity to be determined and specified by the Agency)

3.5 Access Floors

Typically specified by the Architect and compliant with ANSI/ANSI/TIA/EIA 569

3.6 Grounding and Bonding Apparatus

Telecommunications Grounding Busbar (TGB)

Bond with a minimum # 6 AWG, green insulated ground wire extended from the TGB to the main electrical service building ground.

Label grounding and bonding hardware and connections per ANSI/ANSI/TIA/EIA 606A.

Ground Bar Assembly to be constructed with following materials (See drawing details for additional information):

Copper Ground Bar (1/4" x 4" x 13.5")

Provided with Insulators and a support bracket for isolation

Provide lugs for each bonding conductor (BC) and the telecommunications bonding backbone (TBB)

Lugs

The copper alloy lug should be sized for the BC and TBB connecting to the TMGB and the Rack mounted equipment grounding bar.

Hardware (bolts) should be silicone bronze

Rack Mounted Equipment Ground Bar

3/16" x ¾" x 18 5/16" for attachment to 19" mounting rails of equipment racks and cabinets

Splice plate for attachment to multiple racks

#6-32 silicon bronze screws, ground lugs and other mounting hardware

4.0 TELECOMMUNICATIONS ROOM COMPONENTS

4.1 Plywood Backboards

Plywood backboards should be 3/4-inch with a Class AC surface.

Minimum backboard size should be 4' X 8' x ¾"

All sides of each backboard should be painted with two coats of white fire retardant paint prior to installation.

If the local authority having jurisdiction of fire code requires fire-rated plywood, then UL listed fire retardant plywood should be utilized and painted with white fire retardant paint prior to installation.

A fire retardant paint additive may be used and the associated documentation should be applied to the painted backboard as proof of usage.

4.2 Ladder Rack/Cable Runway

Provide ladder rack as shown on drawings for cable support.

Include connecting and all other support hardware for a complete installation including but not limited to equipment rack to runway mounting plates, wall angle support brackets, butt splice swivels, junction splice connections and grounding kits.

Ladder rack should be tubular side bar type nominally 3/8" thick by 1 1/2" high (minimum) with ½" x 1" welded rungs spaced 9" on center.

Finish should be powder coated, black.

4.3 Equipment Racks

Floor mounted equipment racks should meet the following physical specifications and should be installed as shown on the drawings:

Should be manufactured to house 19" wide equipment and be 84" in height

Should have a universal junction hole pattern

Should have #12-24 panel mounting holes

Equipment mounting hole patterns should conform to EIA-310-D

Racks should be capable of supporting a maximum load of 600 Lbs.

Constructed of 6061-T6 aluminum alloy

19" Equipment Grounding Bar (As per manufacturer's recommendations to comply with NEC)

Finished with flat black powder-coat paint

Cable Management for Floor Mounted Equipment Racks

Cable management units should be black metal.

Vertical cable management panels should have front and rear channels.

Vertical cable management panels should have removable front and back covers.

A horizontal manager should be provided at the top of each rack, with a minimum height of 2 rack units each.

Horizontal cable management panels should have front and rear channels.

A horizontal manager should be provided above and below each termination patch panel, with a minimum height of 2 rack units.

Wall Mounted Equipment Racks

Wall Mounted Relay Racks should meet the following physical specifications:

Spaced to mount 19" equipment

Racks should be 48" high with 24 mounting spaces.

Racks should be of a lightweight, high strength steel construction.

19" Equipment Grounding Bar (As per manufacturer's recommendations to comply with NEC)

The color should be a black powder coat finish.

Be capable of stationary mounting with 21" deep, 14 gauge mounting brackets and 100 lb. capacity.

Racks should have double sides EIA universal rack 5/8" to 5/8" - ½" standard hole pattern (compatible with 11/4"" – ½" hole patterns)

Wall Mounted Equipment Cabinets

Wall mounted cabinets should meet the following specifications:

Cabinets should contain 19" equipment mounting rails.

48" high with 26 rack mount spaces.

Universal mounting rails with 10/32 And 12/24 tapped holes.
5/8", 5/8", ½" EIA standard hole pattern.

19" Equipment Grounding Bar (As per manufacturer's recommendations to comply with NEC)

The color should be black powder coat finish.

Racks should have a two hinge design for front and rear access, louvered sides for ventilation, knockouts in top and bottom for cable access Both front and rear access should be lockable.

4.4 Grounding and Bonding Apparatus

Telecommunications Grounding Busbar (TGB)

Bond with a minimum # 6 AWG, green insulated ground wire extended from the TGB to the main electrical service building ground.

Label grounding and bonding hardware and connections per ANSI/ANSI/TIA/EIA 606.

Ground Bar Assembly to be constructed with following materials (See drawing details for additional information):

Copper Ground Bar (1/4" x 4" x 13.5")

Provided with Insulators and a support bracket for isolation

Provide lugs for each bonding conductor (BC) and the telecommunications bonding backbone (TBB)

Lugs

Hardware (bolts) should be silicone bronze and the copper alloy lug should be sized for connecting to the TMGB with the BC and TBB.

Rack Mounted Equipment Ground Bar

3/16" x ¾" x 18 5/16" for attachment to 19" mounting rails of equipment racks and cabinets

Splice plate for attachment to multiple racks

#6-32 silicon bronze screws, ground lugs and other mounting hardware

5.0 BACKBONE CABLING PATHWAYS AND SUPPORT

5.1 Backbone Sleeves and Slots

Sleeves

4” Threaded Galvanized Rigid Steel conduit with plastic insulating bushing on each end for backbone cabling

2” Threaded Galvanized Rigid Steel conduit with plastic insulating bushing on each end for the TBB

Slots

Minimum size 4” x 10”

Minimum two-inch Water Protective dam

Must not obstruct wall termination space

5.2 Backbone Conduit

Provide a minimum of 4” Electrical Metallic Tubing (EMT) with compression fittings for backbone cabling. Setscrew type fittings are unacceptable.

Provide a minimum of 2” Electrical Metallic Tubing (EMT) with compression fittings for the TBB. Setscrew type fittings are unacceptable.

Rigid Galvanized Steel Conduit

RGS conduit should be hot-dipped galvanized steel, including threads.

Electrical Metallic Tubing

Electrical Metallic Tubing should be Electro-galvanized steel.

Fittings

Rigid galvanized steel fittings should be fully threaded and should be of the same material as the respective raceway system.

Compression type fittings should be used for all conduits 2" and larger.

Provide plastic insulating bushings on each end of all conduits.

Die-cast or pressure cast fittings are not permitted.

Pull and Junction Boxes

Junction boxes should be constructed of not less than 14 gauge galvanized steel with trim for flush or surface mounting in accordance with the location to be installed. Provide screw-on type covers.

Boxes installed in damp or wet locations should be of moisture tight construction with gasket covers and threaded

conduit hubs.

In no case should boxes be sized smaller than as indicated in Article 370 of the National Electrical Code for conduit and conductor sizes installed. Boxes should be approved for the environmental condition of the location where they will be installed.

Flush floor junction boxes

Should be recessed cover boxes designed for flush mounting in masonry. Provide brass diamond engraved cover plate with a gasket suitable for foot traffic.

Provide as shown on drawings.

Grounding and Bonding

All conduits should be bonded to the grounding system as per NEC.

Innerduct

Three 1.25", Plenum rated, Innerduct should be installed in each four-inch conduit that will be utilized for fiber optic backbone cabling.

5.3 Vertical Ladder Rack

Provide ladder rack and stand-offs as shown on drawings for support of backbone cables passing vertically through TRs.

Include connecting hardware and all other support hardware for a complete installation including but not limited to equipment rack to runway mounting plates, wall angle support brackets, butt splice swivels, junction splice connections and grounding kits.

Ladder rack should be tubular side bar type nominally 3/8" thick by 1 1/2" high (minimum) with ½" x 1" welded rungs spaced 9" on center.

Finish should be powder coated black.

5.4 Firestopping

Firestopping protection should meet NFPA Life Safety Code #101, 6-2.3.6, "Penetrations and Miscellaneous Openings and Fire Barriers" and the NEC 300.21 "Fire Stopping" regulations and standards.

All penetrations consisting of conduit, sleeves, or chases should be firestopped at the bottom of the penetration.

Openings made in concrete floors should be firestopped using a tested system. Thickness or depth of firestop materials should be as recommended by the material manufacturer and backed by formal ASTM E-814 tests.

All metal conduits designed for communications with or without wire/cable inside should be firestopped to restrict transfer of smoke.

During construction all penetrations must have a temporary firestopping pillow installed.

All firestopping pillows must be reinstalled daily during cable installation and at no time will openings be left unprotected.

Wherever it is not feasible to use a pillow or caulk, use firestopping putty.

6.0 HORIZONTAL CABLING PATHWAYS AND SUPPORT

6.1 Horizontal Conduits and Sleeves

When installed above any ceiling use a minimum 1" Electrical Metallic Tubing (EMT) with set screw type fittings from the TR or cable tray to each work area outlet location. Insulating bushings should be provided at each end of the conduit.

When installed below grade use a minimum 1" Threaded, Galvanized, Rigid conduit from the TR or cable tray to each work area outlet location. Insulating bushings should be provided at each end of the conduit.

Provide a pull string in each conduit.

Rigid Galvanized Steel Conduit

RGS conduit should be hot-dipped galvanized steel, including threads.

Electrical Metallic Tubing

Electrical Metallic Tubing should be Electro-galvanized steel.

Fittings

RGS fittings should be fully threaded and should be of the same material as the respective raceway system.

Compression type fittings should be used for all conduits 2" and larger.

Provide plastic insulating bushings on each end of all conduits.

Die-cast or pressure cast fittings are not permitted.

Pull and Junction Boxes

Boxes should be constructed of not less than 14 gauge galvanized steel with trim for flush or surface mounting in accordance with the location to be installed. Provide screw-on type covers. Boxes installed in damp or wet locations should be of moisture tight construction with gasket covers and threaded conduit hubs.

In no case should boxes be sized smaller than as indicated in Article 370 of the National Electrical Code for conduit and conductor sizes installed. Boxes should be approved for the environmental condition of the location where they will be installed.

Flush Floor Junction Boxes

Should be recessed cover boxes designed for flush mounting in masonry. Provide brass diamond engraved cover plate with a gasket suitable for foot traffic.

Provide as shown on drawings.

Grounding and Bonding

All conduits should be bonded to the grounding system as per NEC.

6.2 Cable Trays

Should be aluminum construction including accessories.

Maximum rung spacing should be 8 in. on centers.

Rungs should be welded to side rails.

Standard length should be 12 ft. - 0 in. long.

A cover should be provided as required by code.

Minimum radius of horizontal elbows should be 12 in. Provide special radius elbows where required for field conditions.

Loading Data:

Useable Tray Width	Load Depth	NEMA Depth	Std.	Span	Lbs / Ft	Deflection
6”	4”					
8”	4”					
12”	4”	3”	12A	10’	81	1.20”
12”	6”	5”	12B	10’	112	0.59”
18”	4”	3”	12A	10’	81	1.20”
18”	6”	5”	12B	19’	112	0.59”
24”	4”	3”	12A	10’	81	1.20”
24”	6”	5”	12B	10’	112	0.59”

Provide a safety-loading factory of 1.5 for uniformly distributed loads when supported as a simple span in accordance with the NEMA standard listed.

Grounding and Bonding

All cable trays should be bonded to the grounding system as per NEC.

6.3 J-hooks

J-hooks are not allowed for new construction. J-hooks may be required in retrofit construction but should be rated to carry the Category of cable to be installed, spaced as per the manufacturer’s recommendation and sized not to exceed the J-hook manufacturer’s recommended quantity of cables.

6.4 Junction Boxes

Boxes should be constructed of not less than 14 gauge galvanized steel with trim for flush or surface mounting in accordance with the location to be installed. Provide screw-on type covers. Boxes installed in damp or wet locations should be of moisture tight construction with gasket covers and threaded conduit hubs.

In no case should boxes be sized smaller than as indicated in Article 370 of the National Electrical Code for conduit and conductor sizes installed. Boxes should be approved for the environmental condition of the location where they will be installed.

Flush Floor Junction Boxes

Should be recessed cover boxes designed for flush mounting in masonry. Provide brass diamond engraved cover plate with a gasket suitable for foot traffic.

Provide as shown on drawings.

6.5 Outlet Boxes

Should be galvanized steel, not less than 2 ¾" deep X 4 11/16" square with knockouts.

Outlet boxes exposed to moisture, exterior, wet or damp locations should be cadmium cast alloy complete with threaded hubs, a gasket and screw fastened covers.

Boxes should be approved for the environmental condition of the location where they will be installed.

Provide a single gang mud ring on all work area outlet boxes.

6.6 Work Area Floor Boxes

Separate work area floor boxes should be provided for communications and electrical devices.

Boxes should be constructed of cast iron

Boxes should house leveling screws for adjusting box to accept floor flange after pour.

Boxes should support 1" conduit minimum.

Covers should be flush with floor and hinged.

Wires should enter the box through a pop up opening in the cover.

Verify the color with the Architect prior to ordering.

6.7 Poke–Throughs

Separate poke through delivery systems should be provided for communications and electrical devices.

Poke-throughs should be suitable for floor thickness of up to 7".

UL File #E146222 listing and ULR14686 fire resistant classification.

Should be constructed of heavy gauge steel and be available in 2 gang, 4 gang or 8 gang arrangements.

Communications conduit should be 1” diameter minimum.

Refer to details on drawing for the exact faceplate requirements.

6.8 Utility Columns

Utility columns should contain a communication and electrical power divider,

The low-voltage channel should be nominally 2" x 1.5” by the height required to extend above the ceiling.

Each column should be equipped with knockouts for two (2), 20 ampere, 125 volt, grounded, duplex receptacles, and knockouts for telephone and data connection.

Columns should be constructed of a minimum of .070" thick, anodized aluminum extrusion, with removable trim plate and cover.

Utility column should be furnished with top plate mounting assembly for easy installation to accessible ceiling.

6.9 Surface Mounted Raceway

Surface mounted raceway is generally not acceptable for new installations but may be required in some renovations.

It is recommended that 1” EMT conduit with a double-gang, surface mounted electrical box and a single-gang device mounting plate be surface mounted in lieu of surface mounted raceway.

Surface Metallic Raceway

Sized to accommodate the total number of cables required and filled less than 40%

Provide devices in the raceway as shown on plans

Should have finish specified by the architect

Provide miscellaneous boxes, fittings and supports designed and manufactured by the raceway manufacturer as required for a complete job.

Surface Non-Metallic Raceway

Finish should be specified by the Architect.

Provide the manufacturers standard fittings as required for the installation. All system components should meet UL 94 requirements for nonflammable, self-extinguishing characteristics.

Raceways should have a voltage rating of 300 Vac maximum.

Should be UL listed.

Fitting should comply with EIA/TIA UTP and Optical Fiber bend radii requirements.

Raceways should have the following wiring capacities:

Provide Communication devices as specified in wiring devices and indicated on the drawings.

Provide dividers in raceways utilized for power and communications.

6.10 Firestopping

Firestopping protection should meet NFPA Life Safety Code #101, 6-2.3.6, "Penetrations and Miscellaneous Openings and Fire Barriers" and the NEC 300.21 "Fire Stopping" regulations and standards.

All penetrations consisting of conduit, sleeves, or chases should be firestopped at the bottom of the penetration.

Openings made in concrete floors should be firestopped using a tested system. Thickness or depth of firestop materials should be as recommended by the material manufacturer and backed by formal ASTM E-814 tests.

All metal conduits designed for communications with or without wire/cable inside should be firestopped to restrict transfer of smoke.

During construction all penetrations must have a temporary firestopping pillow installed.

All firestopping pillows must be reinstalled daily during cable installation and at no time will openings be left unprotected.

Wherever it is not feasible to use a pillow or caulk, use firestopping putty.

7.0 HORIZONTAL CABLING COMPONENTS

7.1 Horizontal UTP Cables

All unshielded twisted pair (UTP) horizontal copper cable supporting voice/data/video communications requirements, as well as Emergency, Courtesy and Pay Telephones should meet a minimum of Category 5e performance specifications as per ANSI/ANSI/TIA/EIA 568B.

At the writing of this revision to the manual, the Category 6 cable standard had not been ratified by ANSI/TIA/EIA.

The cable should meet the following specifications:

Category 5e ANSI/ANSI/TIA/EIA Performance Limits

Frequency MHz	Attenuation dB/100m	Power Sum Near End Crosstalk dB	Pair to Pair Near End Crosstalk DB	Attenuation to Crosstalk Ratio dB/100m
0.772	1.7	67.0	70.0	68.3
1	2.0	65.3	68.3	66.3
4	3.9	56.3	59.3	55.4
8	5.6	51.8	54.8	49.2
10	6.3	50.3	53.3	47.0
16	8.0	47.3	50.3	42.3
20	9.0	45.8	48.8	39.8
25	10.1	44.3	47.3	37.2
31.25	11.4	42.9	45.9	34.5

62.5	16.5	38.4	41.4	24.9
100	21.3	35.3	38.3	17.0
155	27.2	32.5	35.5	8.2
200	31.4	30.8	33.8	2.4
220	33.2	30.2	33.2	0.0
300	39.7	28.2	31.2	n/a
350	43.5	27.2	30.2	n/a

(Continued) Category 5e cables guaranteed performance to 350 MHz over Swept Frequency:

Frequency MHz	Pr-to-Pr ELFEXT db/100m	Power Sum ELFEXT DB/100m	Return Loss dB/100m	Delay Skew ns
0.772	70.0	68.0	n/a	25.0
1	67.8	65.8	20.0	25.0
4	55.7	53.7	23.0	25.0
8	49.7	47.7	24.5	25.0
10	47.8	45.8	25.0	25.0
16	43.7	41.7	25.0	25.0
20	41.7	39.7	25.0	25.0
25	39.8	37.8	24.3	25.0
31.25	37.9	35.9	23.6	25.0
62.5	31.8	29.8	23.0	25.0
100	27.8	25.8	23.0	25.0
155	23.9	21.9	18.8	25.0
200	21.7	19.7	18.0	25.0
220	20.9	18.9	17.7	25.0
300	18.2	16.2	16.8	25.0
350	16.9	14.9	16.3	25.0

Category 6 ANSI/ANSI/TIA/EIA Performance Limits

Category 6 Cable Limits in dB per ANSI/ANSI/TIA/EIA-568B.2-1

Frequency MHz	Insertion Loss per 100m	NEXT pair-to-pair	NEXT power sum	ELFEXT pair-to-pair	ELFEXT power sum	ACR pair-to-pair	ACR power sum	Return Loss Solid
1	2.0	74.3	72.3	67.8	64.8	72.3	70.3	20.0
4	3.8	65.3	63.3	55.8	52.8	61.5	59.5	23.0
8	5.3	60.8	58.8	49.7	46.7	55.5	53.5	24.5
10	6.0	59.3	57.3	47.8	44.8	53.3	51.3	25.0
16	7.6	56.2	54.2	43.7	40.7	48.6	46.6	25.0
20	8.5	54.8	52.8	41.8	38.8	46.3	44.3	25.0
25	9.5	53.3	51.3	39.8	36.8	43.8	41.8	24.3
31.25	10.7	51.9	49.9	37.9	34.9	41.2	39.2	23.6
62.5	15.4	47.4	45.4	31.9	28.9	32.0	30.0	21.5
100	19.8	44.3	42.3	27.8	24.8	24.5	22.5	20.1

200	29.0	39.8	37.8	21.8	18.8	10.8	8.8	18.0
250	32.8	38.3	36.3	19.8	16.8	5.5	3.5	17.3

Category 6 Connecting Hardware Limits in dB per ANSI/ANSI/TIA/EIA-568B.2-1

Frequency MHz	Insertion Loss per 100m	NEXT pair-to-pair	FEXT pair-to-pair	ACR pair-to-pair	Return Loss
1	0.1	75.0	75.0	74.9	30.0
4	0.1	75.0	71.1	74.9	30.0
8	0.1	75.0	65.0	74.9	30.0
10	0.1	74.0	63.1	73.9	30.0
16	0.1	69.9	59.0	69.8	30.0
20	0.1	68.0	57.1	67.9	30.0
25	0.1	66.0	55.1	65.9	30.0
31.25	0.1	64.1	53.2	64.0	30.0
62.5	0.2	58.1	47.2	57.9	28.1
100	0.2	54.0	43.1	53.8	24.0
200	0.3	48.0	37.1	47.7	18.0
250	0.3	46.0	35.1	45.7	16.0

Category 6 Channel Limits in dB per ANSI/ANSI/TIA/EIA-568B.2-1

Frequency MHz	Insertion Loss per 100m	NEXT pair-to-pair	NEXT power sum	ELFEXT pair-to-pair	ELFEXT power sum	ACR pair-to-pair	ACR power sum	Return Loss
1	2.1	65.0	62.0	63.3	60.3	62.9	59.9	19.0
4	4.0	63.0	60.5	51.2	48.2	59.0	56.5	19.0
8	5.7	58.2	55.6	45.2	42.2	52.5	49.9	19.0
10	6.3	56.6	54.0	43.3	40.3	50.3	47.7	19.0
16	8.0	53.2	50.6	39.2	36.2	45.2	42.6	18.0
20	9.0	51.6	49.0	37.2	34.2	42.6	40.0	17.5
25	10.1	50.0	47.3	35.3	32.3	39.9	37.2	17.0
31.25	11.4	48.4	45.7	33.4	30.4	37.0	34.3	16.5
62.5	16.5	43.4	40.6	27.3	24.3	26.9	24.1	14.0
100	21.3	39.9	37.1	23.3	20.3	18.6	15.8	12.0
200	31.5	34.8	31.9	17.2	14.2	3.3	0.4	9.0
250	35.9	33.1	30.2	15.3	12.3	-5.7	-5.7	8.0

Category 6 Permanent Link Limits in dB per ANSI/ANSI/TIA/EIA-568B.2-1

Frequency MHz	Insertion Loss per 100m	NEXT pair-to-pair	NEXT power sum	ELFEXT pair-to-pair	ELFEXT power sum	ACR pair-to-pair	ACR power sum	Return Loss
1	1.9	65.0	62.0	64.2	61.2	63.1	60.1	19.1
4	3.5	64.1	61.8	52.1	49.1	60.6	58.3	21.0
8	5.0	59.4	57.0	46.1	43.1	54.4	52.0	21.0
10	5.5	57.8	55.5	44.2	41.2	52.3	50.0	21.0

16	7.0	54.6	52.2	40.1	37.1	47.6	45.2	20.0
20	7.9	53.1	50.7	38.2	35.2	45.2	42.8	19.5
25	8.9	51.5	49.1	36.2	33.2	42.6	40.2	19.0
31.25	10.0	50.0	47.5	34.3	31.3	40.0	37.5	18.5
62.5	14.4	45.1	42.7	28.3	25.3	30.7	28.3	16.0
100	18.6	41.8	39.3	24.2	21.2	23.2	20.7	14.0
200	27.4	36.9	34.3	18.2	15.2	9.5	6.9	11.0
250	31.1	35.3	32.7	16.2	13.2	4.2	1.6	10.0

C. The cable sheath color for the UTP voice communications cabling should be different from the cable sheath color for the UTP data communications cabling specified.

Typically **white** is used for UTP voice cabling and **blue** is used for data communications.

7.2 Coaxial Video Cables

RG-6 Quadshield type cable should be used. If the run exceeds one hundred (100) feet, RG-11 type cable should be used.

Cable Specifications

All Cable must be 100% shielded

All cable must be 100% sweep tested and certified, 50-550 Mhz. with no abrupt deviation from the loss figures supplied by the manufacturer of the cable.

7.3 Duplex Fiber Optic Cables

Physical Characteristics:

Should be tight buffered two strand, zip cord type, 50/125µm multimode optical fiber for horizontal cabling

Be appropriate for the environment in which it is installed

Multimode optical fiber cables should meet all of the requirements delineated within the specifications of ANSI/ANSI/TIA/EIA-568

Transmission Characteristics:

Attenuation

Multimode Optical fiber cable should perform in accordance with the attenuation limits when tested per ANSI/EIA/TIA-455.

Bandwidth

Multi-Mode should perform in accordance with the bandwidth limits when tested per ANSI/ANSI/TIA/EIA-B.3.

Transmission Distance

The protocol pertinent to the transmission distance for Multimode cable as stated in IEEE 802.3z (Gigabit Ethernet).

Zero Dispersion Wavelength and Slope

Multimode cable should perform in accordance with the Zero Dispersion wavelength and slope limits when tested per ANSI/ANSI/TIA/EIA-568B.3.

7.4 UTP Termination Blocks

The connecting hardware block should support Category 5e, applications and facilitate cross-connection and/or inter-connection using either approved cross-connect wire or patch cords.

Should be 110 type Insulation Displacement Connector (IDC) blocks.
Be UL -Verified

Be ANSI/ANSI/TIA/EIA-568 Category 5e compliant.

Be made of flame-retardant thermoplastic.

Blocks should be 50, 100 or 300 pair sizes.

Blocks should include means to identify cables/services per ANSI/ANSI/TIA/EIA-606A.

Have clear label holders with the appropriate colored inserts available for the wiring blocks. The insert labels provided with the product should contain vertical lines spaced on the basis of circuit size (3, 4 or 5 pair) and should not interfere with running, tracing or removing jumper wire/patch cords. Label holders must be capable of mounting in the under portion of the wiring block.

Have connecting blocks used for either the termination of cross-connect (jumper) wire or patch cords. The connecting blocks should be available in 3, 4 and 5 pair sizes. All connecting blocks should have color-coded tip and ring designation markers and be of single piece construction.

Support wire sizes: Solid or 7-strand 22-26 AWG.

7.5 UTP Patch Panels

Physical Characteristics

Panels should be black anodized aluminum in 24 or 48 port configurations.

Should accommodate 24 ports for each rack mount space (1rms = 44.5 mm [1.75 in.]).

Should have modular jacks made of Beryllium copper with a minimum 50-micro-inch gold plating on contact surfaces over 50-100 micro-inch of nickel compliant with FCC part 68.

Should be available in Universal (T568A/T568B) wiring schemes.

Panels should be equipped with 110-style termination made of fire retardant UL 94V0 rated thermoplastic and tin lead solder plated IDC.

Panels should have port identification numbers on both the front and rear of the panel.

Panels should have optional rear cable support bar for strain relief.

Panels should have self adhesive, clear label holders and white designation labels provided with the panel for each row of 24 ports.

Panels should provide wiring identification & color code and maintain a paired punch down sequence that does not require the overlapping of cable pairs.

Panels should terminate 22-26 AWG solid conductors, maximum insulated conductor outside diameter 0.050".

Transmission Characteristics

Panels should be ANSI/ANSI/TIA/EIA-568B Category 5e compliant.

Panels should be UL VERIFIED for ANSI/TIA/EIA Category 5e electrical performance.

Panels installed in a channel with Category 5e or Category 6 jacks and patch cords shall be from the same manufacturer, and approved Category 5e or Category 6 cable should meet the requirements of Category 5e or Category 6 channels listed in ANSI/ANSI/TIA/EIA-568-B.1.

All panels jacks and patch cords shall be from the same manufacturer and category compliant.

7.6 Video Termination/Patch Panels

Should support F connector bulkhead connectors

Should be installed in equipment racks separate from voice or data cabling or equipment

7.7 Fiber Optic Termination/Patch Panels

Fiber Optic Panels - rack mounted (low fiber count)

All panels and trays (units) should provide cross-connect, inter-connect, splicing capabilities and contain cable management for supporting and routing the fiber cables/jumpers.

Panels should be available in 12 and 24 port with no splicing.

Allow mounting in 19" equipment racks.

Allow flush or 5" recess mounting.

Use adapter plates that house 6 adapters each.

Be available in black.

Should meet or exceed ANSI/ANSI/TIA/EIA 568B.3 requirements.

Provide port configurations and densities as called for on the "T" drawings.

Should be rack mountable.

Should have a hinged removable front cover.

Should feature a front access design with a hinged bulkhead plate.

Should house 6 adapter per adapter plate.

Fiber Optic Panels - rack mount (Moderate fiber count)

All panels and trays (units) should provide cross-connect, inter-connect, splicing capabilities and contain cable management for supporting and routing the fiber cables/jumpers.

Should be available in 12, 24, 48, 72 and 96 port configurations.

Feature a front access design with hinged bulkhead plate.

Use adapter plates that house 6 adapters each.

Have a hinged removable front cover.

Have adapters that are angled to the left of the panel.

Have an integrated vertical cableway on one side of the panel.

Be mountable in flush, 1"2" and 5" recess options.

Be 19" rack mountable.

Have storage and splicing options as part of the product offering.

Provide port configurations and densities as called for on drawings.

Fiber Optic Panels - rack mount (high fiber count)

All panels and trays (units) should provide cross-connect, inter-connect, splicing capabilities and contain cable management for supporting and routing the fiber cables/jumpers.

Should be made of 12-gauge aluminum alloy.

Have blank adapter plates for future growth of the fiber infrastructure.

Have fiber managers to effectively store fiber cable slack and comply with fiber bend radius requirements.

Have six and eight port fiber adapter plates, which allow for color coding connectors.

Accommodate stackable splice trays; each tray manages a total of 24 splices.

Have an adapter plate-mounting bracket, which slides out to the front and to the rear of the unit for increased access.

Have cable access points for fiber jumpers entering and exiting the unit to minimize micro-bending stress.

Have anchor points for fiber cable(s) entering the unit.

Have labeling which meets or exceed ANSI/ANSI/TIA/EIA-606A requirements.

Be able to mount in 19-inch equipment racks/cabinets.

Be UL approved.

Provide port configurations and densities as called for on the “T” drawings.

Fiber Optic Panels - (high fiber count)

All panels and trays (units) should provide cross-connect, inter-connect, splicing capabilities and contain cable management for supporting and routing the fiber cables/jumpers.

Have various termination, splice and storage units available that can be mixed and matched within a common frame.

Support termination densities up to 864 per frame.

Provide port configurations and densities as called for on the “T” drawings.

Fiber Optic trays - rack mount

All panels and trays should provide cross-connect, inter-connect, splicing capabilities and contain cable management for supporting and routing the fiber cables/jumpers.

Be made of 18-gauge steel with a black finish.

Have changeable ports, which are removed from the front of the unit to allow custom configuration or modification.

Have silk screened port identification numbers provided on both the front and rear of the panel.

Include fiber managers that manage slack storage so as to comply with fiber bend radius requirements and slack storage length recommendations.

Accommodate stackable splice trays, which manage up to 24 splices per tray.

Have a cover with quarter turn screws for easy access.

Not exceed a 10” depth for mounting in standard cabinets and enclosures.

Be provided with strain relief lugs for the fiber cable entering the unit from the side or back.

Provide port configurations and densities as called for on the “T” drawings.

7.8 UTP Connectors

The following UTP connectors may be utilized for Data Transmission: ANSI/ANSI/TIA/EIA T568A or ANSI/ANSI/TIA/EIA T568 B.

The following UTP connectors may be utilized for Voice Transmission: USOC, ANSI/ANSI/TIA/EIA T568A and ANSI/ANSI/TIA/EIA 568B.

The following information pertains only to ANSI/ANSI/TIA/EIA T568A and ANSI/ANSI/TIA/EIA T568B UTP connectors.

Physical Characteristics

Jacks should be 8-position non-keyed

Each jack shall be an individually constructed unit and shall snap-mount in an industry standard keystone opening

(.760” x 580”)

Jack housings shall be high impact 94 V0 rated thermoplastic

Jacks shall have an operating temperature range of -10°C (14°F) to 60°C (140°F)

Jack housings shall fully encase and protect printed circuit boards and IDC fields

Modular jack contacts shall accept a minimum of 2500 plug insertions without degradation of electrical or mechanical performance

Contacts shall maintain a minimum vertical deflection force of 110 grams

Modular jack contacts shall be constructed of Beryllium copper for maximum spring force and resilience.

Contact Plating shall be a minimum of 50 micro inches of gold in the contact area over 50 micro-inches of nickel

Jack termination shall be industry standard 110 insulation displacement contact, integral to the jack housing, laid out in 2 arrays of 4 contacts

Jacks shall utilize a paired punch down sequence. Cable pairs shall be maintained up to the IDC, terminating all conductors adjacent to its pair mate to better maintain pair characteristics designed by the cable manufacturer.

Insulation displacement contacts shall utilize tin lead-plated phosphor bronze.

Jacks shall terminate 22-26 AWG stranded or solid conductors.

Jacks shall terminate insulated conductors with outside diameters up to .050”

Jacks shall be compatible with single conductor, industry standard 110 impact termination tools

Jacks shall include wire retention stuffer cap(s) to hold terminated wires in place while allowing to conductors to be viewed in the IDC housing.

Jacks shall be compatible with EIA/TIA 606A color code labeling.

Shall be available in Universal (T568A/T568B) wiring schemes and marked as either T568A, T568B or “Universal”.

The different wiring configurations shall be clearly marked and easily readable.

Jacks shall have an attached color-coded wiring label.

Transmission Characteristics

Jacks shall be designed for 100 Ohm UTP cable termination

Jacks shall be UL Verified and listed for ANSI/ANSI/TIA/EIA category 5e electrical performance.

7.9 Video Connectors

One piece crimp type F connectors

7.10 Fiber Optic Connectors

Small Form Factor or MTRJ connectors are recommended in the horizontal. Consideration should be given to compatibility with equipment.

7.11 Other Multimedia Connectors

As required to support audio and video applications

7.12 UTP Copper Patch Cords and Cross-Connection Cables

All patch cords, patch panels and jacks shall be from the same manufacture and shall be Category compliant with ANSI/ANSI/TIA/EIA 568B.1 Category 5e or Category 6.

Physical Characteristics:

Be round, and consist of eight insulated 24 AWG, stranded copper conductors, arranged in four color-coded twisted-pairs within a flame-retardant jacket

Be equipped with modular 8-position plugs on both ends, wired straight through with standards compliant wiring

Use modular plugs, which exceed FCC CFR 47 part 68 subpart F and IEC 60603-7 specifications, and have 50 micro-inches minimum of gold plating over nickel contacts

Be resistant to corrosion from humidity, extreme temperatures, and airborne contaminants

Be available in several colors with or without color strain relief boots providing snag proof design. Must meet the flex test requirements of 1000 cycles with boots and 100 cycles without boots.

Be available in any custom length and standard lengths of 3, 5, 7, 10, 15, 20 and 25 feet.

Electrical Specifications:

Input impedance without averaging 100 $\Omega \pm 15\%$ from 1 to 100 MHz
100% transmission tested for performance up to 100 MHz. Manufacturer shall guarantee cords are compatible with Category 5e or Category 6 links

Shall utilize cable that is UL Verified.

7.13 Fiber Optic Patch Cords

Physical Characteristics:

Be available in standard lengths of 1, 3, and 5 meters, custom lengths should also be available, and should meet or exceed standards as defined in ANSI/ANSI/TIA/EIA-568B.3.

Utilize duplex optical fiber cable that is 50/125 micron multimode and meets the requirements of UL.

Utilize optical fiber cable where the attenuation should not exceed 3.5 dB/km @ 850 nm wavelength or 1.0 dB/km @ 1300 nm.

Be equipped with Small Form Factor Connectors

Have terminated connectors exhibit a maximum insertion loss of 0.75 dB with an average of 0.50dB when tested at either 850 nm or 1300 nm wavelengths for 50/125 µm.

Have a minimum return loss of 20 dB (25 dB typical) at both 850 nm & 1300 nm.

Be UL approved.

8.0 BACKBONE CABLING COMPONENTS

8.1 Multi-pair Copper Cables

The cable should be available in 25, 50, 100, 150, 200, 300, 400, 600, 900, 1200, 1500, and 1800 pair counts.

UL Listed for Fire Safety

Copper Backbone Cable

All UTP copper backbone cable supporting voice communications requirements should be standard 24 gauge paired dual, semi-rigid CMR or CMP rated as per NEC.

Copper Vertical Backbone Cables

Shielded or unshielded 24 AWG CMR or CMP rated multi-pair copper cables should be used as the vertical backbone riser cables. This cable should support voice applications. The manufacturer's recommended bending radius and pulling strength requirements of all backbone cables should be observed during handling and installation. The multi-pair copper cables should be plenum rated and placed in conduit as required.

Shielded Copper Vertical Backbone Cables

Shielded multi-pair plenum cable should consist of solid-copper conductors insulated with expanded polyethylene covered by a PVC skin, be conformance tested to meet EIA/TIA 568 for Category 3 cable, be UL listed as CMP. The core should be 100% shielded with Aluminum-Mylar and have a drain wire as per manufacturer's specifications.

8.2 Single Mode Fiber Optic Cables

Should be OFNR/OFNP Flame Rated meeting U.L. 1666 rated cables

Class IVa dispersion – unshifted single mode optical fibers complying with ANSI/EIA/TIA-492BAAA.

Primary coating diameter of 250um UV cured acrylate buffer material.

The zero dispersion wavelength should be between 1300 nm and 1324 nm. The ANSI/EIA/TIA-455-168 maximum value of the dispersion slope should be no greater than 0.093 ps/km-nm^2.

Dispersion measurements should be made in accordance with ANSI/EIA/TIA-455-169 or ANSI/EIA/TIA-455-175.

The nominal mode field diameter should be 8.7 um.

Transmission Characteristics:

Maximum attenuation dB/Km @ 1310/1550 nm: 1.0/1.0

The cutoff wavelength should <1279 nm when measured in accordance with ANSI/EIA/TIA-455-170

Physical Characteristics:

900 um tight buffer.

2.0 mm sub-unit diameter.

Should be suitable for indoor installations.

Strength members should be all dielectric.

Secondary thermoplastic type buffer over each fiber.

Should have individual fiber tube colors per ANSI/ ANSI/TIA/EIA-606A with an overall orange jacket.

Provide stiff central member with cables stranded around center.

Provide ripcord for overall jacket.

8.3 Multimode Fiber Optic Cables

Should be OFNR/OFNP Flame Rated meeting U.L. 1666 rated cables

Should be graded-index optical fiber with nominal 50/125um-core/cladding diameter.

Primary coating diameter of 250um UV cured acrylate buffer material.

The fiber should comply with ANSI/EIA/TIA-492AAAA

Transmission Characteristics:

Attenuation should be measured in accordance with ANSI/EIA/TIA-455-46, 53 or 61.

Information transmission capacity should be measured in accordance with ANSI/EIA/TIA-455-51 or 30.

The measurements should be performed at 23 degrees C +/- 5 degrees.

Maximum attenuation dB/Km @ 850/1300 nm: 3.25/1.0

Bandwidth 200 MHz-km @ 850nm

Bandwidth 800 MHz-km @ 1300nm

Physical Characteristics:

900 um tight buffer.

2.0 mm sub-unit diameter.

Suitable for indoor installations.

Strength members should be all dielectric

Secondary thermoplastic type buffer over each fiber.

Should have individual fiber tube colors per ANSI/ANSI/TIA/EIA-606A and an overall orange jacket.

Provide stiff central member with cables stranded around center.

Provide ripcord for overall jacket.

8.4 Coaxial Video Backbone Cables

Should be designed and engineered in accordance with SCTE requirements

8.5 Single Mode Fiber Optic Backbone Connectors

Physical Characteristics

Provide duplex 568SC connectors

The 568SC connectors should meet ANSI/EIA/TIA-604-3 standards.

The connector should have an optical axial pull strength of 2.2 N at 0 degree angle and an optical off axial pull strength of 2.2 N at a 90 degree angle, with a maximum 0.5 dB increase in attenuation for both tests when tested in accordance with ANSI/EIA/TIA-455-6B.

Transmission Characteristics

The maximum optical attenuation per each mated field installed 568SC connector pair should not exceed 0.5 dB.

The total optical attenuation through the cross-connect from any terminated optical fiber to any other terminated fiber should not exceed 1.0 dB.

Should have a return loss greater than or equal to 20 dB for multimode fiber and greater than or equal to 26 dB for single mode fiber.

The connectors should sustain a minimum of 500 mating cycles without degrading this performance.

8.6 Multimode Fiber Optic Backbone Connectors

Physical Characteristics

Provide duplex 568SC connectors

The 568SC connectors should meet ANSI/EIA/TIA-604-3 standards.

The connector should have an optical axial pull strength of 2.2 N at 0 degree angle and an optical off axial pull strength of 2.2 N at a 90 degree angle, with a maximum 0.5 dB increase in attenuation for both tests when tested in accordance with ANSI/EIA/TIA-455-6B.

Transmission Characteristics

The maximum optical attenuation per each mated field installed 568SC connector pair should not exceed 0.5 dB.

The total optical attenuation through the cross-connect from any terminated optical fiber to any other terminated fiber should not exceed 1.0 dB.

Should have a return loss greater than or equal to 20 dB for multimode fiber and greater than or equal to 26 dB for single mode fiber.

The connectors should sustain a minimum of 500 mating cycles without degrading this performance.

8.7 Coaxial Backbone Connectors

Crimp type N connectors for RG -11U

8.8 UTP Termination Blocks - Wall Mounted

The connecting hardware block should support Category 5e, applications and facilitate cross-connection and/or inter-connection using either approved cross-connect wire or patch cords.

Should be 110 type Insulation Displacement Connector (IDC) blocks.

Should be UL Verified

Be ANSI/ANSI/TIA/EIA-568 Category 5e compliant.

Be made of flame-retardant thermoplastic.

Should be 50, 100 or 300 pair sizes.

Blocks should include means to identify cables/services per ANSI/ANSI/TIA/EIA-606A.

Have clear label holders with the appropriate colored inserts available for the wiring blocks. The insert labels provided with the product should contain vertical lines spaced on the basis of circuit size (3, 4 or 5 pair) and should not interfere with running, tracing or removing jumper wire/patch cords. Label holders must be capable of mounting in the under portion of the wiring block.

Have connecting blocks used for either the termination of cross-connect (jumper) wire or patch cords. The connecting blocks should be available in 3, 4 and 5 pair sizes. All connecting blocks should have color-coded tip and ring designation markers and be of single piece construction.

Support wire sizes: Solid or 7-strand 22-26 AWG.

8.9 UTP Termination Blocks – Equipment Rack Mounted

The connecting hardware block should support Category 5e, applications and facilitate cross-connection and/or inter-connection using either approved cross-connect wire or patch cords.

Should be 110 type Insulation Displacement Connector (IDC) blocks.

Be UL -Verified

Be ANSI/ANSI/TIA/EIA-568 Category 5e compliant.

Be made of flame-retardant thermoplastic.

Should be 50, 100 or 300 pair sizes.

Blocks should include means to identify cables/services per ANSI/ANSI/TIA/EIA-606A.

Have clear label holders with the appropriate colored inserts available for the wiring blocks. The insert labels provided with the product should contain vertical lines spaced on the basis of circuit size (3, 4 or 5 pair) and should not interfere with running, tracing or removing jumper wire/patch cords. Label holders must be capable of mounting in the under portion of the wiring block.

Have connecting blocks used for either the termination of cross-connect (jumper) wire or patch cords. The connecting blocks should be available in 3, 4 and 5 pair sizes. All connecting blocks should have color-coded tip and ring designation markers and be of single piece construction.

Support wire sizes: Solid or 7-strand 22-26 AWG.

Should be 300 pair blocks, typical for feed and cable, unless otherwise noted

8.10 Fiber Optic Termination Cabinets - Wall Mounted

All termination cabinets should provide cross-connect, inter-connect and contain cable management for supporting and routing the fiber cables/jumpers.

The wall mount interconnect center should:

Have the ability to mount the cable clamp on the interior of the panel

Provide port configurations and densities as called for on the “T” drawings.

8.11 Fiber Optic Termination Cabinets - Equipment Rack Mounted

All termination cabinets should provide cross-connect, inter-connect and contain cable management for supporting and routing the fiber cables/jumpers.

Capable of supporting from 12 to 144 port versions with fiber adapters preloaded into adapter plates.

Allow for mounting in 19” equipment cabinets.

Be available in black.

The cabinet should have a removable front cover.

Provide port configurations and densities as called for on the “T” drawings.

8.12 Multi-pair Copper Cable Splices

Closure should consist of a split Aluminum or PVC sleeves as indicated on the drawings.

Minimum inside diameter should be 5" (127mm).

Minimum inside length should be 26" (660mm).

Actual sizes should be indicated on the drawings. Otherwise, closure to be sized to accommodate the maximum

number of cable pairs to be spliced and the type of connector to be used for splicing.

Closure should be flame retardant.

Closure should be re-enterable.

When assembled with properly sized end caps, bushing, plugs and clamps, the closure should be air and water tight.

Splice Closure End Caps

End caps should be sized precisely to fit the diameter of the tip cables entering the closure.

Number of openings in the multiple end caps should be determined by dividing the number pairs in the feed cable by 100 and doubling that number. (i.e. 1200 pair cable would have 24 openings for tip cables.

Collared Cap opening can be up to 6.35mm (1/4") larger than the feed cable diameter.

Actual end cap to be provided should be based on the diameter of the feed cable to be spliced.

Plugs

Use tapered or collared plugs as required to fill extra opening in end caps.

Seal if inside diameter of hole is less than 6.35mm (.25").

Bushings

Use rubber or variable bushings as required reducing standard opening in end caps to accommodate custom diameters.

Seal if inside diameter of hole is less than 6.35mm (.25").

Lubricants

Lubricant should evaporate and should not damage closure elements in any way.

Sealing Kits

Kits should consist of a urethane adhesive designed for sealing split vault sleeves and split end caps.

Clamps

Provide Sleeve and Collared clamps as required to complete work.

The designer should require the LVLTC to adhere to all manufacturer installation guidelines.

Bonding Harnesses

Harnesses should be used to ground the shields of the spliced cables.

Bonding harness should be 14 AWG and sized according to closure.

The Designer should require the LVLTC to adhere to all manufacturer installation guidelines.

Splicing Modules

All splicing modules should have an integrated encapsulate in all environments. (ISP and OSP).

Crimping process should strip the installation from the wire and trim the excess wire.

The module should create a gas tight connection.

All modules should have test entry ports on the front side of the module.

Straight splicing modules should have a yellow cover and body top and the base and body bottom should be dark gold.

Pluggable /Bridge splicing modules should have a transparent cover, the body top and bottom should be blue and the insulator should be red.

Splicing Tapes

Tape should be an all-weather, Vinyl Plastic material.

Should resist: Water, Acids, Alkalis

Should be flame retardant

The tape should not be affected by sunlight.

Should release smoothly in zero weather and will not ooze adhesive in hot climates.

Bonding Connectors

Should consist of a base and upper member, two securing nuts and a plastic shoe to aid connector installation and protect the conductors.

Base and upper members should be made of tin plated tempered brass, slightly curved so as to exert a continuous spring form on sheath and shield after clamping.

Grounding Braid

Grounding Braid should be a flat tin plated copper braid conductor.

Grounding Braid should have eyelets at regular intervals.

Eyelets should fit shield connector studs up to 6 mm (1/4") in diameter.

8.13 Fiber Optic Cable Splices

Not recommended

9.0 WORK AREA COMPONENTS

9.1 Flush Wall-mounted Face Plates

Faceplates should be UL Listed.

Faceplates should be constructed of high impact, 94 V-0 rated thermoplastic or stainless steel as per the Architect.

Faceplates should be for single gang outlet boxes

Faceplates should be available to mount one, two, three, four or six jacks in a single gang configuration.

Faceplates should provide for ANSI/ANSI/TIA/EIA 606A compliant station labeling.

Faceplates should have plastic covers over the mounting screws that can be replaced with a clear plastic window over a printable paper insert.

Faceplate' color should be pre approved by the Architect

9.2 Modular Furniture Adapter Plates

Plates should be made of High Impact 94 V-0 rated thermoplastic

Plates should be UL Listed.

Plates should be designed to fit the 2.72" X 1.37" standard opening in Haworth, Knoll, and Steelcase furniture bases

Plates should accept two, three, or four jacks or connectors.

Plates should snap into the modular furniture opening and be retained by integral latching tabs.

Plates should be available in black and gray and have optional port designation stencils.

Plates should snap into the modular furniture opening and be retained by integral latching tabs.

9.3 Floor Box Mounting Frames

Should be106 Style mounting bracket compatible with a Duplex Electrical Outlet faceplate.

9.4 Surface Mounted Housings

Outlet should be capable of accommodating up to 6 fibers and 4 copper cables simultaneously.

Outlets should be of a two-part construction, with a base and a cover.

Outlet cover should snap onto outlet base and come with a screw for securing cover to base.

Outlet ports should be located on the side and bottom when the outlet is mounted to a vertical surface. Port locations on the side should be angled 45 degrees downward to help maintain patch cord bend radii.

Outlet base should have mounting holes that will allow it to be mounted to a standard single or double-gang wall box.

Outlet base should have integral cable storage areas that maintain minimum bend radius for optical fiber and allow the storage of at least 1 m of slack for each of the 6 fibers installed.

Outlet base should accommodate cable entry from the top and back and should have an integral jack termination holder.

Outlet should be UL Listed.

Outlet should be constructed of high impact, 94 V-0 rated, Office White thermoplastic.

Outlet should accommodate Small Form Factor optical fiber adapters.

Outlet should be compatible with a two-channel non-metallic raceway.

Outlet cover should have ANSI/ANSI/TIA/EIA 606A standard compliant label areas.

9.5 Multimedia Housings

Multimedia outlet housings should be capable of accommodating up to 12 cables, of any combination of media.

Housings should be of a two-part construction, with a base and a cover.

The cover should snap onto the outlet base and come with a screw for securing cover to base.

The cover should have a label area compliant with ANSI/TIA/EIA 606A

Outlet ports should be located on the bottom when the outlet is mounted to a vertical surface.

The housing base should have mounting holes that will allow it to be mounted to a standard single or double-gang wall box.

Outlet base should have integral cable storage drum that maintains minimum bend radius of 1.18" for optical fiber and allows the storage of at least 1 m of slack for up to 12 optical fiber cables.

Outlet should accommodate cable entry from the top, sides, and back.

Outlet should be UL Listed.

Outlet should be constructed of high impact, 94 V-0 rated, Office White thermoplastic.

Outlet should be compatible with a two-channel non-metallic raceway.

Outlet should be field configurable for use with multiple cable types and should have brackets for UTP, BNC, F, and RCA connectors, and Small Form Factor optical fiber adapters.

10.0 ADMINISTRATION AND LABELING PRODUCTS

10.1 General

Administration of the telecommunications infrastructure includes documentation of cables, termination hardware, patching and cross-connection facilities, conduits, other cable pathways, telecommunications closets, and other telecommunications spaces. ANSI/ANSI/TIA/EIA-606A, the Administration Standard for the Telecommunications Infrastructure of Commercial Buildings is the industry standard for administering and documenting the telecommunications infrastructure. The purpose of the standard is to provide a uniform administration scheme that is independent of applications, which may change several times throughout the life of a building. This standard establishes guidelines for owners, end users, manufacturers, installers, and facilities administrators involved in the administration of the telecommunications infrastructure.

The administration system is built upon "identifiers" and "records". The system is used to document the existing

infrastructure, and to manage and administer adds, moves, and changes to the telecommunications infrastructure and telecommunications systems. The size and complexity of the infrastructure at a facility will dictate the level of detail required in the administration system.

All state facilities should apply and maintain a system for documenting and administering the telecommunications infrastructure. The administration system should include cable records, and equipment records for all information technology systems (voice, data, and video). The administration system should follow the ANSI/ANSI/TIA/EIA-606A standard.

Hand Written Labels are not acceptable

10.2 Backbone Conduit

Minimum three inch square surface area tag mechanically stamped, legible and permanently affixed.

Acceptable tagging materials are copper, brass or 1/16 inch thick plastic.

The tag should be approved by the GTA/RCDD prior to use.

10.3 Backbone Cables

Self adhesive, self laminating mechanically printed with a clear protective laminating over-wrap or mechanically printed heat shrink tubing.

The label should be approved by the GTA/RCDD prior to use.

10.4 Horizontal Cables

Self adhesive, self laminating mechanically printed with a clear protective laminating over-wrap or mechanically printed heat shrink tubing.

The label should be approved by the GTA/RCDD prior to use.

10.5 Riser Backbone Conduits

Minimum three inch square surface area tag mechanically stamped, legible and permanently affixed.

Acceptable tagging materials are copper, brass or 1/16 inch plastic.

The label should be approved by the GTA/RCDD prior to use.

10.6 Cable Trays

Minimum three inch square surface area tag mechanically stamped, legible and permanently affixed.

Acceptable tagging materials are copper, brass or 1/16 inch plastic.

The label should be approved by the GTA/RCDD prior to use.

10.7 Equipment Bonding Conductor

Self adhesive, self laminating, mechanically printed with a clear protective laminating over wrap or mechanically

printed heat shrink tubing

The label should be approved by the GTA/RCDD prior to use.

10.8 Entrance Conduits

Minimum three inch square surface area tag mechanically stamped, legible and permanently affixed.

Acceptable tagging materials are copper, brass or 1/16 inch plastic.

The label should be approved by GTA prior to use.

10.9 Telecommunication Spaces

Spaces should be identified the same as on the Architectural drawings and approved by the Architect.

10.10 Telecommunications Grounding Busbar

Minimum three-inch square surface area tag mechanically stamped, legible and permanently affixed.

Acceptable tagging materials are copper, brass or 1/16 inch plastic.

The tag should be approved by the GTA/RCDD prior to use.

10.11 Equipment Racks and Cabinets

Nameplates should be white with black core laminated phenolic nameplates with 3/8 inch lettering etched through the outer covering.

Each nameplate should be fastened with stainless steel screws to each rack.

10.12 UTP Patch Panels

Nameplates should be white with black core laminated phenolic nameplates with 3/8 inch lettering etched through the outer covering.

Each nameplate should be fastened with stainless steel screws to each rack.

10.13 UTP Termination Blocks

White 3/8" self adhesive Mylar tape with ¼" black mechanically produced lettering

The label should be approved by the GTA/RCDD prior to use.

10.14 Pull Boxes

Provide ¾ inch black stenciled letters on a painted orange rectangular background.

10.15 Splices

Minimum three inch square surface area tag mechanically stamped, legible and permanently affixed.

Acceptable tagging materials are copper, brass or 1/16 inch plastic.

The tag should be approved by the GTA/RCDD prior to use.

10.16 Telecommunications Main Grounding Busbar

Minimum three inch square surface area tag mechanically stamped, legible and permanently affixed.

Acceptable tagging materials are copper, brass or 1/16 inch plastic.

The tag should be approved by GTA prior to use.

10.17 Work Area Outlets

White 3/8" self adhesive Mylar tape with ¼" black mechanically produced lettering

The label should be approved by the GTA/RCDD prior to use.

B. CUSTOMER OWNED OSP/INTERBUILDING PRODUCTS

1.0 CONDUIT AND INNERDUCT

1.1 Four-Inch Nonmetallic Conduit (Schedule 40 PVC)

Conduit

Should be corrosion resistant

UL listed for exposed or outdoor usage

Manufactured to meet NEMA TC-2, Federal specification WC1094A and UL 651 specifications

Should be nonconductive

Should be Bell Ended Electrical Nonmetallic Conduit

Dimensions: O.D.: 4.50", I.D.: 4.026", Wall .237"

Listed for underground applications encased in concrete or direct buried

Sunlight Resistant

Rated for use with 90° C conductors

Should carry both UL and ETL listings and labels

Fittings

Should be manufactured to meet NEMA TC-3, Federal specification WC1094A and UL514B

Should carry both UL and ETL listings and labels

Dimensions: O.D.: 4.50", I.D.: 4.026", Wall .237"

Should be bell ended

Cement

Only cement recommended by the manufacturer for use with all grades of PVC conduit and fittings should be used.

1.2 Four-inch, Galvanized, Rigid-steel Conduit

Should be threaded hot-dipped galvanized steel.

1.3 Corrugated Innerduct

The corrugated innerduct should be constructed of a PVC plastic.

Should be 1.25" diameter or as called for on the "T" drawings.

The innerduct should be orange in color.

2.0 MAINTENANCE HOLES and HANDHOLES

2.1 Maintenance Holes

Provide pre-cast or cast-in-place reinforced concrete designed for H-20 loading.

Maintenance holes should have angled corners, cut on 45 degrees for optimum cable racking.

Covers and frames should be cast iron, with a minimum opening of 27" suitable for H-20 loading. Covers should have pick opening holes and have “Telephone”, “Communications”, "Signal" or “CATV” cast in 2” high lettering on the cover, per Agency's directive.

Floors should be a minimum of 6 inches thick and sloped to a 12” diameter sump hole.

In wet soil, the maintenance hole should have a reinforced floor with 5/8” bars, 8 inches on center.

Adjust frame to grade by providing a minimum two courses of bricks with all joints fully filled with mortar both inside and outside the collar. Provide layer of mortar on top course for bricks.

Provide cable racks with “T” slots for attaching support hooks. Provide a minimum of two racks per wall.

Provide pulling irons on each wall 12” below duct.

2.2 Handholes

It is recommended that handholes be 48”w x 72”l x 36”d.

Covers are to be rated H-20, 25,000 psi.

Covers must bolt down.

All handholes are to have a minimum of 8 inches of gravel placed in the bottom of the handhole.

All hand holes should be equipped with two 36” cable racks on each wall and four 7.5” rack hooks for each cable rack.

Hand holes of additional depths as required ensuring minimum conduit depth is maintained throughout.

The cover should be labeled Telephone, Communications, Signal or CATV and be cast in 2” high lettering on the cover.

Handholes should be pre-cast polymer concrete type.

3.0 GROUNDING AND BONDING

3.1 Aerial

Aerial cable and support should be grounded and bonded as per RUS and ANSI/ANSI/TIA/EIA 758 requirements.

3.2 Underground

Grounding requirements for underground cable plant should be as per RUS and ANSI/ANSI/TIA/EIA 758 requirements.

4.0 AERIAL SUPPORT

4.1 Utility Poles

Only Class 5 poles should be utilized if aerial applications use aerial applications should be are pre-approved by GTA to avoid problems later.

4.2 Messenger and Guying Strand

Only messenger strand sized for the application will should be utilized if for aerial applications are pre-approved by GTA.

Provide 3/16" diameter 7-wire galvanized "6M" steel messenger strand as noted on the drawings. Messenger strand should to be manufactured to ASTM A475 specifications and be accepted by RUS standards. Strand should is to be at least a utilities grade, have a minimum breaking strength of 5,500 pounds, have a left lay and at least an "A" rated galvanized coating weight.

Strand Connectors

Provide and install all B strand connectors, suspension/cable clamps, grounding tap clamps, hangers, 1-bolt and 3-bolt clamps to adequately support the strand as typically indicated.

For strand runs in excess of 15' between structural columns, additional ½" rod supports and appropriate strand clamps (such as 3-hole clamp) should be provided and installed on minimum 25' centers, per the project manager's direction.

4.3 Galvanized Steel Attachment Hardware

Provide and install the appropriate S guy bolts, wall straps and brackets as necessary to adequately support the cable.

S guy bolts (or commonly called anchor rods or thimble-eye bolts) should be a minimum 5/8" diameter with a straight shank and be designed for attaching messenger strand deadends. The bolt length should be at least 4" longer than the width of the structural steel flange it will be attached to.

B beam clamps, or approved equivalent, should be designed to be used for dead-ending strand on the flange of structural steel members (columns and beams). B beam clamp should be designed for use with a 5/8" S guy bolt.

4.4 Lashing Wire

Provide stainless steel type 430 lashing wire with .045" minimum diameter.

4.5 Grounding Apparatus

As per RUS and ANSI/ANSI/TIA/EIA 758 requirements

4.6 Guying Apparatus and Anchors

Guying Strand

Provide 3/16" diameter 7-wire galvanized "6M" steel strand as noted on the drawings.

Guying strand should is to be manufactured to ASTM A475 specifications and be accepted by RUS standards.

Strand should is to be at least a utilities grade, have a minimum breaking strength of 5,500 pounds, have a left lay and at least an "A" rated galvanized coating weight.

Guying Anchor

Should be an eight way anchor designed for installation in an 8" hole with 135 sq. in. area and should include a ¾" thimble eye bolt.

Should be one piece top plate that expands upon impact into undisturbed earth to form a cone shaped square to distribute the anchors holding power over a wide area.

Anchor should be covered with asphalt paint to protect against corrosive soil conditions.

Rod should be hot dipped galvanized

5.0 BACKBONE CABLING

5.1 Multi-pair Copper Cables

The multi-pair copper cables should be sized as indicated on the drawings.

Should consist of a core of 24 AWG solid annealed copper conductors, color coded in accordance with telephone industry standards.

Cable should be suitable, listed and marked for use in a duct application.

The manufacturers' cable code, pair size, manufacturing plant location, month and year or manufacture should be marked on cable every two feet.

5.2 Fiber Optic Cables

Multimode

Multimode fiber should be graded-index optical fiber with 50/125um-core/cladding diameter.

The cable should be loose tube construction with a water-blocking agent construction.

The fiber should comply with ANSI/EIA/TIA-492AAAA

Transmission Characteristics for Multimode Fiber Optic Cable: Each cabled fiber should meet the graded performance specifications below. Attenuation should be measured in accordance with ANSI/EIA/TIA-455

Information transmission capacity should be measured in accordance with ANSI/EIA/TIA-455-51 or 30. The measurements should be performed at 23 degrees C +/- 5 degrees.

Maximum attenuation dB/Km @ 850/1300 nm: 3.25/1.0

Bandwidth 200 Mhz-km @ 850nm

Bandwidth 800 Mhz-km @ 1300nm

Single Mode

Class IVa dispersion - unshifted single mode optical fibers complying with ANSI/EIA/TIA-492BAAA.

Primary coating diameter of 250um UV cured acrylate buffer material.

The zero dispersion wavelength should be between 1300 nm and 1324 nm. The ANSI/EIA/TIA-455-168 maximum value of the dispersion slope should be no greater than .093 ps/km-nm^2.

Dispersion measurements should be made in accordance with ANSI/EIA/TIA-455-169 or ANSI/EIA/TIA-455-175.

Transmission Characteristics:

Maximum attenuation dB/Km @ 1310/1550 nm: 1.0/1.0

The cutoff wavelength should <1279 nm when measured in accordance with ANSI/EIA/TIA-455-170

Physical Characteristics:

The cable should be loose tube with a water-blocking agent construction.

Strength members should be all dielectric.

The cable should have a secondary thermoplastic type buffer over each fiber.

The cable should be suitable for installation in underground or above ground conduits.

Should have individual fiber tube colors per ANSI/ANSI/TIA/EIA-606A

Provide stiff central member with cables stranded around center.

Provide ripcord for overall jacket.

The cable should be suitable for -40^o to +75^o C.

The cable should be suitable for lashing.

Should be UV rated when used for exterior/aerial installations.

The cable may be armored for added rodent protection.

5.3 Coaxial Video Cables

All interbuilding coaxial cable should be engineered for the application and meet the requirements of the SCTE.

5.4 Copper Cable Splice Cases

Closure should consist of a split Aluminum or PVC sleeves as indicated on the drawings.

Minimum inside diameter should be 5" (127mm).

Minimum inside length should be 26" (660mm).

Actual sizes should be indicated on the drawings. Otherwise, closures should be sized to accommodate the maximum number of cable pairs to be spliced and the type of connector to be used for splicing.

Closure should be flame retardant.

Closure should be re-enterable.

When assembled with properly sized end caps, bushing, plugs and clamps, the closure should be air and water tight.

Splice Closure End Caps

End caps should be sized precisely to fit the diameter of the tip cables entering the closure.

Number of openings in the multiple end caps should be determined by dividing the number pairs in the feed cable by 100 and doubling that number. (i.e. 1200 pair cable would have 24 openings for tip cables.

Collared Cap opening can be up to 6.35mm (1/4") larger than the feed cable diameter.

Actual end cap to be provided should be based on the diameter of the feed cable to be spliced.

Plugs

Use tapered or collared plugs as required to fill extra opening in end caps.

Seal if inside diameter of hole is less than 6.35mm (.25").

Bushings

Use rubber or variable bushings as required reducing standard opening in end caps to accommodate custom diameters.

Seal if inside diameter of hole is less than 6.35mm (.25").

Lubricants

Lubricant should evaporate and should not damage closure elements in any way.

Sealing Kits

Kits should consist of a urethane adhesive designed for sealing split vault sleeves and split end caps.

Clamps

Provide Sleeve and Collared clamps as required to complete work.

The Designer should require the LVLTC to adhere to all manufacturer's installation guidelines.

Bonding Harnesses

Harnesses should be used to ground the shields of the spliced cables.

Bonding harness should be 14 AWG and sized according to closure.

The Designer should require the LVLTC to adhere to all manufacturer's installation guidelines.

Splicing Modules

All splicing modules should have an integrated encapsulate in all environments. (ISP and OSP).

Crimping process should strip the installation from the wire and trim the excess wire.

The module should create a gas tight connection.

All modules should have test entry ports on the front side of the module.

Straight splicing modules should have a yellow cover and body top and the base and body bottom should be dark gold.

Pluggable /Bridge splicing modules should have a transparent cover, the body top and bottom should be blue and the insulator should be red.

Splicing Tapes

Tape should be an all-weather, Vinyl Plastic material.

Tape should resist: Water, Acids and Alkalis.

Tape should be flame retardant.

Tape should not be affected by sunlight.

Should release smoothly in zero weather and will not ooze adhesive in hot climates.

Bonding Connectors

Should consist of a base and upper member, two securing nuts and a plastic shoe to aid connector installation and protect the conductors.

Base and upper members should be made of tin plated tempered brass, slightly curved so as to exert a continuous spring form on sheath and shield after clamping.

Grounding Braid

Grounding braid should be a flat tin plated copper braid conductor.

Grounding Braid should have eyelets at regular intervals.

Eyelets should fit shield connector studs up to 6 mm (1/4") in diameter.

5.5 Fiber Optic Cable Splice Cases

Splice cases should meet Bellcore Testing requirements GR-771-CORE.

Splice cases should be constructed of durable glass-filled high-density thermoplastic shells.

Should be capable of reentry and utilize a neoprene gasket seal.

Splice cases should be 22" long x 8.5" in maximum diameter.

Splice cases should be capable of storing a minimum of 288 splices.

Splice cases should be suitable for direct burial, underground or aerial installation.

End plates should have a minimum of six cable entry ports, captive hardware, strength member tie-off, isolated grounds and require no field drilling.

Splice Trays

Trays should be compatible with the splice case specified.

6.0 ADMINISTRATION AND LABELING

6.1 Backbone Conduits

Minimum three inch square surface area tag mechanically stamped, legible and permanently affixed.

Acceptable tagging materials are copper, brass or 1/16 inch plastic.

Tag should be approved by the GTA/RCDD prior to use.

6.2 Telecommunications Bonding Conductors

Minimum three inch square surface area tag mechanically stamped, legible and permanently affixed.

Acceptable tagging materials are copper, brass or 1/16 inch plastic.

Tag should be approved by the GTA/RCDD prior to use.

6.3 Service Entrance Conduits

Minimum three inch square surface area tag mechanically stamped, legible and permanently affixed.

Acceptable tagging materials are copper, brass or 1/16 inch plastic.

Tag should be approved by the GTA/RCDD prior to use.

6.4 Backbone Cables

Minimum three inch square surface area tag mechanically stamped, legible and permanently affixed.

Acceptable tagging materials are copper, brass or 1/16 inch plastic.

Tag should be approved by the GTA/RCDD prior to use.

6.5 Handholes

Cover should be labeled “Telephone”, “Communications”, "Signal" or “CATV” cast in 2” high lettering on the cover.

Minimum three inch square surface area tag mechanically stamped, legible and permanently affixed.

Acceptable tagging materials are copper, brass or 1/16 inch plastic.

Tag should be approved by the GTA/RCDD prior to use.

6.6 Maintenance Holes

Cover should be labeled “Telephone”, “Communications”, "Signal" or “CATV” cast in 2” high lettering on the cover.

Minimum three inch square surface area tag mechanically stamped, legible and permanently affixed.

Acceptable tagging materials are copper, brass or 1/16 inch plastic.

Tag should be approved by the GTA/RCDD prior to use.

6.7 Utility Poles

Minimum three inch square surface area tag mechanically stamped, legible and permanently affixed.

Acceptable tagging materials are copper, brass or 1/16 inch plastic.

Tag should be approved by the GTA/RCDD prior to use.

6.8 Splices

Minimum three inch square surface area tag mechanically stamped, legible and permanently affixed.

Acceptable tagging materials are copper, brass or 1/16 inch plastic.

Tag should be approved by the GTA/RCDD prior to use.

EXECUTION

A. GENERAL RECOMMENDATIONS

1.0 System Design and Overview

It is desired by the State of Georgia to have a uniform cabling plan in each building/facility for voice, data and video distribution to allow for flexible changes, office renovations, equipment migrations and constant upgrades. This cabling system is based on industry standardized structured cabling systems that are not proprietary and conform to current ANSI/ANSI/TIA/EIA Commercial Cabling Standards.

The committee recommends following the general cabling industry practice of using a Structured Cabling System (SCS). Other cabling systems may be installed in addition to the SCS but at the minimum the committee recommends that a SCS be installed. A SCS attempts to cable a building for telecommunications needs without knowing specifically what equipment will be utilized. A SCS is geared for long-term stability and flexibility and is based on the idea of wiring the building once. The SCS approach allows the cable and telecommunications outlets to remain unchanged while the connections and services vary.

1.1 Forbidden Work Not Recommended

Other than the entrance splice, no cable splices should be allowed within buildings.

Aerial cable construction should not be permitted without prior written GTA/RCDD approval.

1.2 Site Examination

The LVLTC should verify that surfaces are ready to receive work.

The Designer should specify that field measurements as shown on the construction drawings are not exact and should be verified by the LVLTC prior to commencement of work.

Proceeding with installation indicates that the installer accepts all existing conditions.

1.3 Telecommunications Room Common Equipment

In order to serve the function, Telecommunication rooms (TRs) must be able to contain telecommunications equipment, cable terminations and associated cross-connect cabling. Telecommunication rooms must should have the space and environmental facilities required by the electronic equipment used in today's networks, including hubs, switches, terminal concentrators, backbone multiplexing systems, fiber optic patch panels, horizontal cabling patch panels and other devices

TR space should be dedicated to the telecommunications function.

TRs should not be shared by other building services such as Electrical (i.e. Electrical Distribution Panels or Transformers) or custodial services (i.e. cleaning carts, solvents, buffers, etc.). Either pose a threat of damage or EMF interference that makes them totally unacceptable for telecommunications equipment & cabling TRs should not contain any type of sink, water heater or be used as storage for custodial or any other such supplies.

Telecommunications Rooms should not be used for storage of any kind. (I.e. books, furniture, A/C filters, light Bulbs, etc…)

Equipment not related to the support of the TR (e.g., piping, ductwork, pneumatic tubing, etc.) should not be installed, pass through or enter the TR.

1.4 Cable Installation

Contractor should utilize only water-based cable-pulling lubricant for all pulls in conduit ducts or innerducts. Petroleum based lubricants should not be used.

Manufacturer's recommended pulling tensions should be monitored and not exceeded.

Cable damaged during installation should be replaced at the installer's expense.

1.5 Coordination with other Trades

Cable routing should be designed and installed so cabling and associated equipment does not interfere with the operation or maintenance of any other equipment. No wiring should be hung, tied to, or supported from anything other than the telecommunications raceway, cable tray or telecommunications conduit.

All cable in accessible spaces should be designed and installed for easy access. Cable paths above suspended ceilings, mechanical rooms, closets, etc. should not be blocked or covered in any way that would impede the addition of cable in the future.

1.6 Conduit

To support voice and data communications requirements install one (1) inch conduit from the work area outlet box to the cable tray or telecommunications room. All horizontal cabling should be concealed in conduit or in the cable tray above the ceiling.

Conduit sleeves should be four (4) inch trade size minimum. Sleeves shall be Rigid Galvanized Steel for penetrations of concrete slabs, concrete walls. All sleeves shall be rigidly installed using appropriate fittings and all penetrations shall be grouted around the sleeve. Sleeves shall project a minimum of six (6) inches beyond wall or floor surface. All penetrations shall be firestopped. Sleeves for penetration of walls and floors shall not be filled greater than 50%, shall have 100% spare capacity (spare conduits) and all conduits shall be firestopped as per code.

Any section of conduit containing two (2) 90-degree bends, a reverse bend or having length greater than one hundred (100) feet shall have an accessible pullbox.

All conduits with less than a 40% fill ratio shall have a pull cord secured at each end.

All metallic conduit, raceways and cable tray shall be appropriately grounded as specified in the NEC, ANSI/ANSI/TIA/EIA 607 and per manufacturer's specifications.

Supports and fasteners should be used to hold all cables, conduits, and trays firmly in place. Supports and fasteners should be used that provide an adequate safety factor.

Contractor should install a pulling cord in each empty conduit and secure the cord at each end.

1.7 Horizontal Cabling

Maximum installed cable distance should not exceed 250 feet. While the ANSI/ANSI/TIA/EIA standards allow horizontal cabling to be 295 feet the State of Georgia wishes to ensure an additional margin of reliability by limiting horizontal cabling distances to 250 feet.

All voice, data, fiber, and video outlets should be installed in the locations as marked on the "T" drawings.

Prior to installing any cabling, floor plans and detail drawings indicating all jack numbering should be pre-approved by the GTA/RCDD.

Data Jacks For Wireless Access Points

All wireless access points should be located below an accessible ceiling. If areas designated for wireless access do not have accessible ceilings the jack location should be determined by the GTA/RCDD and the Agency

All horizontal UTP voice cabling shall meet Category 5e standards (minimum).

All horizontal UTP data cabling should meet Category 5e or Category 6 standards (minimum).

1.8 Building Backbone Cabling

The size of the multi-pair backbone riser cables for voice communications from the MER to each TR should be determined as follows:

Total # of Pairs = (Number of outlets x 4 + 20%)

Example: 50 stations X 4 = 200 + 40(20%) = 240 pairs

Increase multi-pair riser to the next highest manufactured cable-pair size after utilizing the formula above.

1.9 Re-routing of Existing OSP Telecommunications Utilities

Re-route any voice, data and video cables that are currently located in the footprint of the new facility being constructed.

Notify the State Owner at least two (2) weeks in advance prior to any outage, re-routing of any existing voice, data, and/or video cables. The outage should be scheduled at the convenience of the State.

Any customer owned OSP cable that is to be re-routed must be re-terminated and tested.

Operating Telcos may require, up to six months notice prior to relocation of their existing utilities. Costs associated with the relocation will usually be at the Agency's expense.

1.10 Broadband Cabling

The telecommunications cabling Designer should require the LVLTC to adhere to the video system designer's specifications.

1.11 Certification, Testing and Acceptance

GTA can not provide telecommunications services to buildings prior to acceptance and approval of all "As-Built" drawings and technical documentation.

All required documents must be received and approved by the GTA/RCDD, the Agency and the Architect three weeks prior to the Agency occupying the facility.

As-built documentation should include the completed and notarized original copy of the Structured Cabling System registration documentation.

All intrabuilding, interbuilding cabling, equipment and all site restoration should be installed and complete in accordance with this manual, the State and industry standards.

All cabling and equipment provided and/or installed should be fully tested as described and be fully operational.

After all work is complete provide the State Owner with the manufacturer's certification for all communications work completed on the project.

1.12 Record Documents, As-Built Drawings and other Project Information

Provide the following information, prior to acceptance of the building by the State, for each of the specified media:

Cable identification numbers (Copper, Fiber, Coax).

Cable design makeup (Copper, Fiber, Coax).

Cable lengths between splice points and terminations. (Copper, Fiber, Coax)

Exact routing of cable (Copper, Fiber, Coax).

Splice location and identification (Copper, Fiber, Coax).

Strand count, mode of installed fiber, loss per splice in dB, and total amount of optical fibers installed (Fiber).

Frequency rating, location and identification of amplifiers and splitters (Coax).

Bonding and grounding (Copper, Fiber, Coax).

Location and description of all associated structures and obstructions. (Copper, Fiber, and Coax).

Cable entrance locations and penetration details (Copper, Fiber, Coax).

Terminal information, outlet numbering, and pair count information at each distribution frame (Copper).

Schematic drawings of riser (Copper, Fiber, Coax).

Routing of cable and termination information (Copper, Fiber, Coax).

Cable pair counts per connector block.

Provide a complete listing of pair count records for copper wiring, optical fiber cabling, and coaxial cabling.

Copper cable records should include the status of each copper pair. Optical fiber cable records should include strand allocation, test results, and identification of media and protocol used.

The Contractor should provide the State with the operational and maintenance documentation of all telecommunications equipment installed under this contract.

As-Built drawings should include actual locations of installed ductbank and manholes, including elevations, and shall indicate location, elevation and type of service for all utilities crossed by the new ductbank.

The Designer should require the LVLTC to provide all drawings on 3.5-inch floppy diskettes utilizing AutoCAD R14, or (Latest Version).

B. BUILDING INFRASTRUCTURE / INTRABUILDING PRODUCTS

1.0 SERVICE ENTRANCE COMPONENTS

1.1 Plywood Backboards

The General Contractor should install backboards as shown on the "T" drawings, 6" above the finished floor to 8'6" AFF. Mounting should be sufficient to support the equipment.

Backboards should be mounted with a minimum of 3/8" toggle bolts or concrete anchors and 2" fender washer on each corner and 4' on center as required.

All sides of each backboard should be painted with two coats of white fire retardant paint prior to installation.

If the local authority having jurisdiction requires fire-rated plywood, then UL listed fire retardant plywood should be utilized and painted with white fire retardant paint prior to installation.

A fire retardant paint additive may be used and the associated documentation should be applied to the painted backboard as proof of usage.

Linear wall space used for anchoring equipment should be lined for the full room width with plywood, per the drawings.

Install distribution rings for the cross-connect fields above all wall mounted blocks. Two rings per vertical row of blocks. Mount rings with two hex head screws per ring.

1.2 Ladder Rack / Cable Runway

Install as shown on the "T" drawings.

Should be installed 84" AFF and as per manufacturer's recommendations and secured to the top of all equipment racks.

The cable runway should be supported at three foot intervals with triangular support brackets from the walls and securely attached to the racks/cabinets.

Cable radius drops should be attached to the ladder rack to maintain cable bending radius where cables enter and exit the runway.

Cable should be secured to the runway using reusable Velcro type cable ties to arrange cable in logical bundles.

Communication grounding and bonding should be in accordance with applicable codes and regulations. It is recommended that the requirements of ANSI/ANSI/TIA/EIA-607, the NEC and be observed throughout the entire system.

1.3 Customer Owned Underground Copper Backbone Cables

Contractor should provide 2 days advance notice prior to pulling any cable greater than 400 pairs in size or when a winch is planned for use.

The Agency's representative and the GTA/RCDD should be present to observe all pulling activities of cable greater than 400 pairs or when a winch is planned for use.

Cable bend radius should not be exceeded and be maintained at least 10 times the diameter of the cable.

Contractor should be responsible for verifying that ducts are ready for occupancy prior to cable placement.

Contractor should assume responsibility for any difficulties or damage to the cable during placement.

Cable feeder guides should be used between the cable reel and the face of the duct.

Cable should be monitored and inspected for sheath defects, as it is fed off the reel. Pulling operations should be stopped and the GTA/RCDD should be notified if a defect or any other irregularity is found.

Cable should be fed off from the top of the reel.

The Designer should require the LVLTC to adhere to all manufacturers' requirements regarding pulling tension allowable lubricants and bending radius.

Use Line Tension meter during cable pull to provide accurate measurement of the force exerted on a cable as it is installed. The meter should have a programmable overload set point with an audible and visual indication of an overload condition. The meter should have controls to disengage the cable puller if an overload condition occurs. Provide chart recorded information of the cable pull for the Agency's records.

Secure all cables as required with heavy duty ty-wraps to cable racking and steps.

Ground and bond all cable shields as per NEC and ANSI/ANSI/TIA/EIA 607.

All cable shields are to be grounded at both ends with a minimum #6 solid soft copper ground wire as required by code.

All cable pairs should be terminated.

Cables should be tested and the results documented on pre-approved test sheets.

Cables should be labeled as specified on the "T" drawings

1.4 Customer Owned Aerial Copper Backbone Cables

The Designer should require the LVLTC should provide at least 2 days advance notice prior to pulling any cable greater than 400 pairs in size or when a winch is planned for use.

The Agency's representative and the GTA/RCDD should be present to observe all pulling activities of cable greater than 400 pairs or when a winch is planned for use.

Cable bend radius should be maintained at least 10 times the diameter of the cable.

Contractor should assume responsibility for any difficulties or damage to the cable during placement.

Cable should be watched and inspected for sheath defects, as it is fed off the reel. Placement operations should be stopped and the GTA/RCDD shall be notified if a defect or any other irregularity is found.

Cable should be fed off from the top of the reel.

The Designer should require the LVLTC to adhere The Designer should require the LVLTC to adhere to all manufacturer's requirements regarding pulling tension and bending radius.

Secure all cables as required with heavy duty lashing wire to strand.

Ground and bond all cable at the lightning protection.

All cables to be grounded at the MDF end with a minimum #6 solid soft copper ground wire as required by code.

All cable pairs should be terminated.

Cables should be tested and the results documented on approved test sheets.

Cables should be labeled as specified on the "T" drawings

1.5 Copper Backbone Cable Splice Cases

Encapsulated Closures

The Designer should require the LVLTC to adhere to all manufacturer installation guidelines.

The Designer should require the LVLTC to support closures at both ends via racks and step, so that no unnecessary stress or weight is applied to the splice case or associated conductors.

End Caps and Closure Extension Sleeves

The Designer should require the LVLTC to adhere to all manufacturers' installation guidelines.

Encapsulants

The Designer should require the LVLTC to adhere to all manufacturers' installation guidelines.

Splicing Tapes

The Designer should require the LVLTC to adhere to all manufacturer usage guidelines.

Gel Stripper

The Designer should require the LVLTC to adhere to all manufacturer usage guidelines.

Bonding and Grounding

The Designer should require the LVLTC to bond the metallic sheath and the splice case to an appropriate ground at all splice locations

The Designer should require the LVLTC to bond the shield of shielded cable to the ground bar in communications rooms and spaces, per applicable code and
The manufacturer's recommended practices.

1.6 Copper Backbone Primary Cable Protectors

The protectors should be mounted as indicated on the "T" drawings.

The Designer should require Contractor to field verify actual length required for the input and output protector stubs.

The Designer should require Contractor to provide clear labeling at the splice end of the cable referencing, rack, row and block information.

The Designer should require Contractor to install a minimum # 6 Grounding wire as straight as possible from terminal to Grounding Bar.

Surge Protection Modules

The Designer should require the LVLTC to install the surge protection modules per the manufacturer's installation instructions

The Designer should require the LVLTC to fill all protectors to 100 percent capacity using the appropriate manufacturers Surge Protection Modules.

The Designer should require the LVLTC to fully protect all pairs entering a building with active pair surge protection modules.

1.7 Optical Fiber Transition Splice Cabinets

In general splicing of fiber optic cables is only allowed to transition from an outdoor rated cable to an Indoor rated cable and should be avoided whenever possible.

Should be installed as indicated on the "T" drawings.

Should be installed per the manufacturer's installation instructions.

Should be bonded to ground as required by the NEC and ANSI/ANSI/TIA/EIA 607.

Should be labeled in accordance with ANSI/ANSI/TIA/EIA 606A.

1.8 Copper Cable Termination Blocks

Should be installed on the plywood backboard so that the top of the termination block is 5'6" AFF or in equipment racks as noted on the "T" drawings.

Blocks should be mounted with steel, zinc plated 5/16" - #10 x 3/4" drill screws with a minimum of four screws per block.

Install designation strips color-coded in conformance with ANSI/TIA/EIA 606A standard as follows:

Description	Color
C.O. Circuits	Orange
Common Equipment	Purple
First Level Back Bone Cable	White
Second Level Back Bone Cable	Gray
Horizontal Wiring	Blue
Auxiliary Circuits – Alarms, Security	Yellow
Future use and Key Systems	Red
Inter-building Campus Backbone	Brown

1.9 Grounding and Bonding Apparatus

The Designer should require the LVLTC to The electrical contractor shall install the properly sized grounding busbar in each telecommunications equipment room as required by ANSI/ ANSI/TIA/EIA 607 and the NEC.

All metallic equipment racks, conduits, cable trays, ladder racks, etc. should be bonded to the grounding busbar.

All bonding connectors and clamps should be mechanical type made of silicon bronze.

Terminals should be solderless compression type, copper long-barrel NEMA two bolts.

The Designer should require the LVLTC to bond the shield of shielded cable to the ground bar in communications rooms and spaces, per applicable code and manufacturers recommended practices.

Communication grounding and bonding should be in accordance with applicable codes and regulations. It is recommended that the requirements of ANSI/ ANSI/TIA/EIA-607, the NEC and be observed throughout the entire system.

Should be labeled in accordance with ANSI/ ANSI/TIA/EIA 606A.

2.0 MAIN EQUIPMENT ROOM COMPONENTS

2.1 Plywood Backboards

The General Contractor should install backboards 6” above the finished floor to 8’6” AFF. Mounting should be sufficient enough to support the equipment.

Should be mounted with a minimum of 3/8” toggle bolts and 2” fender washer on each corner and 4’ on center as required.

All sides of each backboard should be painted with two coats of white fire retardant paint prior to installation.

If the local authority having jurisdiction requires fire-rated plywood, then UL listed fire retardant plywood should be utilized and painted with white fire retardant paint prior to installation.

A fire retardant paint additive may be used and the associated documentation should be applied to the painted backboard as proof of usage.

Linear wall space used for anchoring equipment should be lined for the full room width with plywood, per the drawings.

Install distribution rings for the cross-connect fields above all wall mounted blocks. Two rings per vertical row of blocks. Mount rings with two hex head screws per ring.

2.2 Ladder Rack / Cable Runway

The LVLTC should install Ladder Rack as shown on the "T" drawings.

Should be installed 84" AFF and as per manufacturer's recommendations and to the top of equipment rack.

Cable runway should be supported at three foot intervals from the ceiling, walls, floor and/or rack/cabinet.

Cable radius drops should be attached to the ladder rack stringers or rungs to facilitate cable entering and exiting the runway while protecting the physical properties of the cable.

Cable should be secured to the runway using reusable cable ties to arrange cable in logical bundles.

Communication grounding and bonding should be in accordance with applicable codes and regulations. It is recommended that the requirements of ANSI/ANSI/TIA/EIA-607, the NEC and be observed throughout the entire system.

2.3 Equipment Racks

The LVLTC should install equipment racks as per the manufacturer's recommendations and as shown on the "T" drawings.

Racks should be assembled such that mounting rails are perpendicular to the base.

Should be secured to the ladder rack as per the ladder rack manufacturer's recommendations

Racks should be secured to the floor using appropriate anchors.

Provide front and rear vertical and horizontal management cable as shown on "T" drawings.

The Designer should require the LVLTC to mount with a minimum of 36" feet clear access behind and in front of each rack.

Communication grounding and bonding should be in accordance with the NEC. It is recommended that the requirements of ANSI/ANSI/TIA/EIA-607 be observed throughout the entire cabling system.

At a minimum, The Designer should require the LVLTC to bond the rack to the equipment ground bar with a #6 copper wire.

All racks should be labeled in accordance with ANSI/ANSI/TIA/EIA 606A.

2.4 Grounding and Bonding Apparatus

The electrical contractor should install the properly sized grounding busbar in each telecommunications equipment room as required by ANSI/ANSI/TIA/EIA 607 and the NEC.

All metallic equipment racks, conduits, cable trays, ladder racks, etc. should be bonded to the grounding busbar.

All bonding connectors and clamps should be mechanical type made of silicon bronze.

Terminals should be solderless compression type, copper long-barrel NEMA two bolts.

Bond the shield of shielded cable to the ground bar in communications rooms and spaces, per applicable code and manufacturers recommended practices.

Communication grounding and bonding should be in accordance with applicable codes and regulations. It is recommended that the requirements of ANSI/ANSI/TIA/EIA-607 and NEC be observed throughout the entire cabling system.

All grounding and bonding apparatus should be labeled in accordance with ANSI/ANSI/TIA/EIA 606A

3.0 MAIN COMPUTER ROOM COMPONENTS

3.1 Plywood backboards

The General Contractor should install backboards 6" above the finished floor to 8'6" AFF. Mounting should be sufficient enough to support the equipment.

Backboards should be mounted with a minimum of 3/8" toggle bolts or concrete anchors and 2" fender washer on each corner and 4' on center as required.

All sides of each backboard should be painted with two coats of white fire retardant paint prior to installation.

If the local authority having jurisdiction requires fire-rated plywood, then UL listed fire retardant plywood should be utilized and painted with white fire retardant paint prior to installation.

A fire retardant paint additive may be used and the associated documentation should be applied to the painted backboard as proof of usage.

Linear wall space used for anchoring equipment should be lined for the full room width with plywood, per the "T" drawings.

Install distribution rings for the cross-connect fields above all wall mounted blocks. Two rings per vertical row of blocks. Mount rings with two hex head screws per ring.

3.2 Ladder Rack / Cable Runway

The LVLTC should install ladder rack as shown on the "T" drawings.

Should be installed 84" AFF and as per manufacturer's recommendations and secured to the top of equipment rack/cabinet.

The cable runway should be supported at three foot intervals from the ceiling, walls, floor and/or rack/cabinet.

Cable radius drops should be attached to the ladder rack stringers or rungs to facilitate cable entering and exiting the runway while protecting the physical properties of the cable.

Cable should be secured to the runway using reusable cable ties to arrange cable in logical bundles.

Communication grounding and bonding should be in accordance with applicable codes and regulations. It is recommended that the requirements of ANSI/ANSI/TIA/EIA-607, the NEC and be observed throughout the entire

system.

3.3 Equipment Racks

The LVLTC should install equipment racks as per manufacturer's recommendations and as shown on the "T" drawings.

Racks should be assembled such that mounting rails are perpendicular to the base.

Ladder rack should be secured to the equipment racks as per the ladder rack and equipment rack manufacturer's recommendations

Should be secured to the floor using appropriate anchors.

Provide front and rear vertical and horizontal management cable as shown on drawing.

Mount with a minimum of 36" feet clear access behind and front of rack from the wall to a rack.

Communication grounding and bonding should be in accordance with applicable codes and regulations. It is recommended that the requirements of ANSI/ANSI/TIA/EIA-607, the NEC and be observed throughout the entire system. At a minimum bond the rack to the equipment ground bar with a #6 copper wire.

All racks should be labeled in accordance with ANSI/ANSI/TIA/EIA 606A

3.4 Equipment Cabinets

Should be assembled and installed by the LVLTC according to manufacturer's instructions.

Should be placed to allow three feet of clearance on all sides.

Should be placed as indicated on the "T" drawings.

Should be bonded to ground as required by the NEC and ANSI/ANSI/TIA/EIA 607.

All cabinets should be labeled in accordance with ANSI/ANSI/TIA/EIA 606A.

3.5 Access Floors

All access floors should be installed by the General Contractor as specified by the Architect and as indicated on the "T" drawings.

3.6 Grounding and Bonding Apparatus

The electrical contractor should install the properly sized grounding busbar in each telecommunications equipment room as required by ANSI/ANSI/TIA/EIA 607 and the NEC.

All metallic equipment racks, conduits, cable trays, ladder racks, etc. should be bonded to the grounding busbar.

All bonding connectors and clamps should be mechanical type made of silicon bronze.

Terminals should be solderless compression type, copper long-barrel NEMA two bolts.

The Designer should require the LVLTC to bond the shield of shielded cable to the ground bar in communications rooms and spaces, per applicable code and manufacturers recommended practices.

Communication grounding and bonding should be in accordance with applicable codes and regulations. It is recommended that the requirements of ANSI/ANSI/TIA/EIA-607, the NEC and be observed throughout the entire system.

All grounding and bonding apparatus should be labeled in accordance with ANSI/ANSI/TIA/EIA 606A.

4.0 TELECOMMUNICATIONS ROOM COMPONENTS

4.1 Plywood backboards

The General Contractor should install backboards 6" above the finished floor to 8'6" AFF. Mounting should be sufficient enough to support the equipment.

Should be mounted with a minimum of 3/8" toggle bolts and 2" fender washer on each corner and 4' on center as required.

All sides of each backboard should be painted with two coats of white fire retardant paint prior to installation.

If the local authority having jurisdiction requires fire-rated plywood, then UL listed fire retardant plywood should be utilized and painted with white fire retardant paint prior to installation.

A fire retardant paint additive may be used and the associated documentation should be applied to the painted backboard as proof of usage.

Linear wall space used for anchoring equipment should be lined for the full room width with plywood, per the drawings.

Install distribution rings for the cross-connect fields above all wall mounted blocks. Two rings per vertical row of blocks. Mount rings with two hex head screws per ring.

4.2 Ladder Rack / Cable Runway

The LVLTC should install ladder rack as shown on the "T" drawings.

Should be installed 84" AFF and as per manufacturer's recommendations and to the top of equipment rack.

The cable runway should be supported at three-foot intervals from either the ceiling, walls, floor or rack/ cabinet.

Cable radius drops should be attached to the ladder rack stringers or rungs to facilitate cable entering and exiting the runway while protecting the physical properties of the cable.

Cable should be secured to the runway using reusable cable ties to arrange cable in logical bundles.

Communication grounding and bonding should be in accordance with applicable codes and regulations. It is recommended that the requirements of ANSI/ANSI/TIA/EIA-607, the NEC and be observed throughout the entire system.

Cable runway/ ladder rack is the only recommended horizontal support when installing Category 6 horizontal cables.

4.3 Equipment Racks

Equipment racks should be installed by the LVLTC as per manufacturer's recommendations and as shown on the "T" drawings.

Should be assembled such that mounting rails are perpendicular to the base.

Should be secured to the ladder rack as per the ladder rack manufacturer's recommendations

Should be secured to the floor using appropriate anchors.

Provide front and rear vertical and horizontal management cable as shown on drawing.

Mount with a minimum of 36" feet clear access behind and front of rack from the wall to a rack.

Communication grounding and bonding should be in accordance with applicable codes and regulations. It is recommended that the requirements of ANSI/ANSI/TIA/EIA-607, the NEC and be observed throughout the entire system. At a minimum bond the rack to the equipment ground bar with a #6 copper wire.

All equipment racks should be labeled in accordance with ANSI/ANSI/TIA/EIA 606A.

4.4 Grounding and Bonding Apparatus

The electrical contractor should install the properly sized grounding busbar in each telecommunications equipment room as required by ANSI/ANSI/TIA/EIA 607 and the NEC.

All metallic equipment racks, conduits, cable trays, ladder racks, etc. should be bonded to the grounding busbar.

All bonding connectors and clamps should be mechanical type made of silicon bronze.

Terminals should be solderless compression type, copper long-barrel NEMA two bolts.

The Designer should require the LVLTC to bond the shield of shielded cable to the ground bar in communications rooms and spaces, per applicable code and manufacturers recommended practices.

Communication grounding and bonding should be in accordance with applicable codes and regulations. It is recommended that the requirements of ANSI/ANSI/TIA/EIA-607 and NEC be observed throughout the entire cabling system.

All grounding and bonding apparatus should be labeled in accordance with ANSI/ANSI/TIA/EIA 606A.

5.0 BACKBONE CABLING PATHWAYS AND SUPPORT

5.1 Backbone Sleeves and Slots

Sleeves

Should be pre-approved by the Architect/Structural Engineer.

Should be sized and installed by the General Contractor where indicated on the "T" drawings.

The Designer should require the LVLTC to attach cored sleeves on each side of the floor / wall using 1.25 inch support struts and the appropriate conduit clamps to support the sleeves.

Cored sleeves should extend a minimum of 3-inches above the finished floor and 3 inches below the poured concrete structure.

Cored holes should be sealed as a barrier to prevent smoke and water infiltration between the core hole and the conduit.

Place vertical ladder rack on the wall below or above all sleeves from the floor to the ceiling above, as indicated on the "T" drawings.

Each sleeve and/or slot should be labeled in accordance with ANSI/ANSI/TIA/EIA 606A

Slots

Should be pre-approved by the Architect/Structural Engineer.

Should be sized and installed by the General Contractor where indicated on the "T" drawings.

The Designer should require the LVLTC to place vertical ladder rack on the wall above/below all slots from the floor to the ceiling above.

The Designer should require the LVLTC to provide a minimum of a two-inch water protective dam.

Each sleeve and/or slot should be labeled in accordance with ANSI/ANSI/TIA/EIA 606A.

5.2 Backbone Conduit

All electrical conduits shall be installed by the electrical contractor and as per NEC.

Electrical Metallic Tubing (EMT) and Rigid Metal Conduit (RMC) are the only approved conduit types. Flexible metal conduit is not recommended.

Conduits larger than 1 inch should be joined using compression fittings only.

All conduit fittings should be installed per the manufacturer's instructions.

Factory made sweeps should be used for 1" trade size and larger.

Bend radius should be 6 times the internal diameter for conduit sizes up to 2 inches.

A conduit greater than 2 inch should have bend radius at least 10 times the diameter of the conduit.

All conduits should be terminated with insulating bushings at both ends.

Runs exceeding 100 feet or 180 degrees total bends should be broken with suitable sized pull boxes. LB or similar conduit fittings are not acceptable.

Conduit should be supported as required by the manufacturer and the NEC.

Pull boxes should not be located at bends.

Only sweeping bends should be used.

Conduit runs to work areas should serve no more than one (1) work area outlet.

Conduits should be sized as follows:

CONDUIT CAPACITY CHART

Conduit Size	Category 5E Typically 0.19 O.D. Capacity	Category 6 Typically 0.240 O.D. Capacity
1"	11	7
1 1/4"	20	13
1 1/2"	27	18
2"	44	29
2 1/2"	64	42
3"	98	65
3 1/2"	132	87
4"	170	112

This chart is for typical installations only. Actual fill capacity should be based on individual manufacturers O.D. using 40% fill capacity.

Plug the ends of each roughed-in conduit with an approved cap or disc prior to installation of cables to prevent the entrance of foreign materials and moisture during construction. All conduits should be clean and dry prior to installation of telecommunication cabling.

Conduit should be secured within three feet of each outlet box, junction box or fitting.

Provide a pull string in all conduit runs to facilitate installation of cables. Secure the pull string at both ends.

Conduits installed in concrete floor slabs as follows:

Conduit in concrete floor slabs should be galvanized rigid steel with concrete tight threaded fittings.

The Designer should require the LVLTC to provide expansion fittings where conduits cross building expansion joints.

The Designer should require the LVLTC to install conduit below the reinforcing mesh.

The Designer should require the LVLTC to locate conduits to provide a minimum of 1” of concrete around conduit.

Wherever a cluster of four (4) or more exposed conduits rise out of the floor, The Designer should require the LVLTC to provide a neatly formed 4-in. high concrete envelope with chamfered edges around the cluster of conduits

Roof penetrations are generally not recommended. In some cases the Architect may allow roof penetrations for support of roof mounted satellite dishes or other communications equipment. . All roof penetrations should be pre-approved by the Architect and a detailed design provided.

Identification: Clearly label conduit and pull boxes within 6 inches of the exposed ends and as per ANSI/ANSI/TIA/EIA 606A.

All conduit ends should have insulating bushings installed at both ends.

Conduits should not be installed adjacent to hot surfaces or in wet areas.
Provide expansion fittings with external grounding straps at building expansion joints.

Conduits, outlets, pull boxes, and junction boxes should be installed to allow ergonomic access.

Install junction and pull boxes in readily accessible locations. Equipment, piping, ducts and the like should not block access to boxes.

5.3 Vertical Ladder Racks

Vertical ladder rack should be installed by the LVLTC.

The Designer should require the LVLTC to place vertical ladder rack on the wall above/below all slots from the floor to the ceiling above.

Vertical Ladder racks should be installed as shown on the "T" drawings.

Stand offs should be installed as necessary to support the required ladder rack.

The anchoring system provided should be suitable for the type of wall and the weight to be supported by the ladder rack.

5.4 Firestopping

Firestopping protection should be provided by the LVLTC and should meet NFPA Life Safety Code #101, 6-2.3.6, "Penetrations and Miscellaneous Openings and Fire Barriers" and the NEC 300.21 "Fire Stopping" regulations and standards.

All vertical penetrations consisting of conduits, sleeves, or chases should be firestopped at the top and bottom of each penetration.

All horizontal penetrations consisting of conduits, sleeves or chases should be firestopped on both sides of each penetration.

Openings made in concrete floors shall be firestopped using a tested system.

Thickness, depth and installation of firestop materials shall be as recommended by the material manufacturer and backed by formal ASTM E-814 tests.

Plenum air return ceiling penetrations for conduit should be sealed with a system appropriate for the substrate and the level of protection required.

All metal conduits designed for telecommunications with or without cable installed should be firestopped to prevent transfer of smoke.

During construction all slots and sleeves must have a firestopping pillow installed.

All firestopping pillows must be reinstalled daily during cable installation and at no time should conduits, slots or sleeves be left unprotected with firestop material.

All sleeves must have a firestopping caulk applied to the outside circumference of the sleeve on each side of the wall penetration and from the top and bottom of a floor penetration.

6.0 HORIZONTAL CABLING PATHWAYS AND SUPPORT

6.1 Horizontal Conduits and Sleeves

Conduits

All conduits shall be installed by the Electrical Contractor.

Electrical Metallic Tubing and Rigid Metal Conduit are the only approved conduit types. Flexible metal conduit is not recommended.

Conduits larger than 1 inch should be joined using compression fittings only.

All conduit fittings should be installed per the manufacturer's instructions.

Factory made sweeps should be used for 1" trade size and larger.

Bend radius should be 6 times the internal diameter for conduit sizes up to 2 inches.

Runs exceeding 100 feet or 180 degrees total bends should be broken with suitable sized pull boxes. LB or similar conduit fittings are not recommended.

Conduit should be supported as required by the manufacturer and the NEC.

Pull boxes should not be located at bends.

Only sweeping bends should be used.

Conduit runs to work areas should serve no more than one (1) work area outlet.

Conduits should be sized as follows:

CONDUIT CAPACITY CHART

Conduit Size	Category 5E 0.19OD Capacity	Category 6 0.240 OD Capacity
1"	11	7
1 1/4"	20	13
1 1/2"	27	18
2"	44	29
2 1/2"	64	42
3"	98	65
3 1/2"	132	87
4"	170	112

This chart is for typical installations only. Actual fill capacity should be based on individual mfg OD using 40% fill capacity.

Plug the ends of each roughed-in conduit with an approved cap or disc to prevent the entrance of foreign materials and moisture during construction.

Conduit should be secured within three feet of each outlet box, junction box or fitting.

The Designer should require the LVLTC to provide a pull string in all conduit runs to facilitate installation of cables. Secure the pull string at both ends.

Conduit s installed in concrete floor slabs as follows:

Conduit in concrete floor slabs should be galvanized rigid steel with concrete tight threaded fittings.

The Designer should require the LVLTC to provide expansion fittings where conduits cross building expansion joints.

The Designer should require the LVLTC to install conduit below the reinforcing mesh.

The Designer should require the LVLTC to locate conduits to provide a minimum of 1" of concrete around conduit.

The Designer should require the contractor to provide a neatly formed 4-in. high concrete envelope with chamfered edges around cluster when four (4) or more exposed conduits rise out of the floor.

Identification: The Designer should require the LVLTC to clearly label conduit and pull boxes within 6 inches of the exposed ends and as per ANSI/ ANSI/TIA/EIA 606A.

All conduit ends should have insulating bushings installed.

Conduits should not be installed adjacent to hot surfaces or in wet areas.

The Designer should require the LVLTC to provide expansion fittings with external grounding straps at building expansion joints.

Conduits, outlets, pull boxes, and junction boxes should be installed to allow ergonomic access.

The Designer should require the LVLTC to install junction and pull boxes in readily accessible locations. Equipment, piping, ducts and the like should not block access to boxes.

Sleeves

Should be pre-approved by the Architect/Structural Engineer, sized and installed where indicated on the "T" drawings.

Attach cored sleeves on each side of the floor / wall using 1.25 inch support struts and the appropriate conduit clamps to support the sleeves.

Cored sleeves should extend a minimum of 3-inches through the finished wall on each side of the wall.

Cored holes should be sealed as a barrier to prevent smoke and water infiltration between the core hole and the conduit.

6.2 Cable Trays

All cable trays shall be installed by the Electrical Contractor.

Install as shown on the "T" drawings.

Should be installed a minimum of 6 inches above the finished ceiling and a maximum of 2 feet above the finished ceiling and per manufacturer's recommendations and to the top of equipment rack.

The cable tray should be supported at a minimum five foot intervals from the ceiling and as the manufacturer recommends.

The cable tray should be installed to allow access to both sides of the cable tray above the ceiling.

Cable trays should be installed to allow ergonomic access to both sides of the cable trays.

Install The Designer should require the LVLTC to install cable trays in readily accessible locations. Equipment, piping, ducts and the like should not block access to both sides of the cable trays.

Cable radius drops should be attached to the cable tray stringers or rungs to facilitate cable entering and exiting the tray while protecting the physical properties of the cable.

Cable should be secured to the cable tray and arrange the cable in neat logical bundles.

Communication grounding and bonding should be in accordance with applicable codes and regulations. It is recommended that the requirements of ANSI/ANSI/TIA/EIA-607and NEC be observed throughout the entire cabling system.

6.3 J-hooks

J-hooks are not allowed for new construction. J-hooks may be required in retrofit construction but should be rated to carry the Category of cable to be installed, spaced as per the manufacturer's recommendation and sized not to exceed the J-hook manufacturer's recommended quantity of cables.

6.4 Junction Boxes

Junction boxes should be installed to by the Electrical Contractor to allow for ergonomic access.

The Designer should require the LVLTC install junction boxes in readily accessible locations. Equipment, piping, ducts and the like should not block access to boxes.

Conduit should be secured within three feet of each junction box.

Junction boxes should be anchored per manufacturer's instructions.

Junction boxes should not be located at bends.

Runs exceeding 100 feet or 180 degrees total bends should be broken with suitable sized junction boxes. LB or similar conduit fittings are not recommended.

Identification: Clearly label all junction boxes as per ANSI/ANSI/TIA/EIA 606A.

6.5 Work Area Outlet Boxes

Work area outlet boxes should be installed by the Electrical Contractor to allow for ergonomic access.

The Designer should require the LVLTC install work area outlet boxes only in readily accessible locations. Equipment, piping, ducts and the like should not block access to boxes.

Conduit should be secured within three feet of each work area outlet box.

Work area outlet boxes should not be located at bends.

6.6 Work Area Floor Boxes

All work area floor boxes shall be installed by the Electrical Contractor.

The Designer should require the LVLTC to install separate work area floor boxes for communications and electrical devices.

The Designer should require the LVLTC to install the work area floor boxes using the leveling screws for adjusting box to accept floor flange after pour.

The Designer should require the LVLTC to install a minimum 1" conduit to each work area floor box.

The Designer should require the LVLTC to install the covers to ensure the top of the cover is flush with the finished floor surface.

The Designer should require the LVLTC to install covers per manufacturer's installation instructions.

The Designer should require the LVLTC to verify the color and coordinate the flooring type with the Architect prior to ordering.

6.7 Poke–Throughs

Poke –Throughs should be pre-approved by the GTA/RCDD and the Architect.

Poke-throughs shall be installed by the Electrical Contractor.

The Designer should require the LVLTC to install separate poke through delivery systems for communications and electrical devices.

The Designer should require the LVLTC to install a minimum 1" diameter conduit.

Install poke-throughs as indicated on the "T" drawings.

6.8 Utility Columns

Should be installed by the Electrical Contractor as per manufacturer's installation instructions.

Install utility columns as indicated on the "T" drawings

6.9 Surface Mounted Raceway

Surface raceway is generally not acceptable recommended or appropriate for new installations but may be required in

renovations.

6.10 Firestopping

Firestopping protection should be installed by the LVLTC and should meet NFPA Life Safety Code #101, 6-2.3.6, "Penetrations and Miscellaneous Openings and Fire Barriers" and the NEC 300.21 "Fire Stopping" regulations and standards.

All vertical penetrations consisting of conduits, sleeves, or chases should be firestopped at the top and bottom of each penetration.

All horizontal penetrations consisting of conduits, sleeves or pipe chases should be firestopped on both sides of each penetration.

Openings made in concrete floors should be firestopped using a tested system.

Thickness, depth and installation of firestop materials shall be as recommended by the material manufacturer and backed by formal ASTM E-814 tests.

Plenum air return ceiling penetrations for conduit should be sealed with a system appropriate for the substrate and the level of protection required.

All metal conduits designed for telecommunications with or without cable installed should be firestopped to prevent transfer of smoke.

During construction all slots and sleeves should have a firestopping pillows installed.

All firestopping pillows should be reinstalled daily during cable installation and at no time should conduits, slots or sleeves be left unprotected with firestop material.

All sleeves must should have a firestopping caulk applied to the outside circumference of the sleeve on each side of the wall penetration and from the top and bottom of a floor penetration.

7.0 HORIZONTAL CABLING COMPONENTS

7.1 Horizontal UTP Cables

All horizontal UTP cable should be installed by the LVLTC per the manufacturer's installation recommendations.

All horizontal UTP cable shall be placed as shown on the "T" drawings.

All horizontal UTP cable concealed in walls or soffits should be installed in metal conduits.

All horizontal UTP cable above ceilings should be installed in cable tray or conduit.

Do not untwist horizontal UTP cable pairs more than 0.5 in. when terminating.

All installed horizontal UTP cables should pass the category 5e testing requirements ANSI/ANSI/TIA/EIA 568B.

Maximum installed horizontal UTP cable length should not exceed 250 feet.

Horizontal UTP able should have no physical defects such as cuts, tears or bulges in the outer jacket. Horizontal UTP

cables with defects should be replaced.

Install horizontal UTP cable in neat and workmanlike manner per the BICSI Installation Manual.

All installed horizontal UTP cables should be placed or routed per the manufacturer's recommendations.

Maintain the following clearances from EMI sources:

Power - 12 in.
Fluorescent Lights - 12 in.
Transformers - 36 in.

7.2 Horizontal Coaxial Video Cables

All horizontal coaxial video cables should be installed by the LVLTC per the manufacturer's installation recommendations.

All horizontal coaxial video cables shall be placed as shown on the "T" drawings.

All horizontal coaxial video cables concealed in walls or soffits should be installed in metal conduits.

All horizontal coaxial video cables above ceilings should be installed in cable tray or conduit.

All installed cables should pass the testing requirements of ANSI/ANSI/TIA/EIA 568B.

Maximum installed horizontal cable length should not exceed 250 feet.

Horizontal coaxial video cables should have no physical defects such as cuts, tears or bulges in the outer jacket. Horizontal coaxial video cables with defects should be replaced.

Install horizontal coaxial video cables in a neat and workmanlike manner per the BICSI Installation Manual.

All installed horizontal coaxial video cables should be placed or routed per the manufacturer's recommendations.

Maintain the following clearances from EMI sources:

Power - 12 inches
Fluorescent Lights - 12 inches
Transformers - 36 inches

7.3 Horizontal Duplex Fiber Optic Cables

All horizontal duplex fiber optic cable should be installed by the LVLTC per the manufacturer's installation recommendations.

All horizontal duplex fiber optic cable shall be placed as shown on the "T" drawings.

All horizontal duplex fiber optic cable concealed in walls or soffits should be installed in metal conduits.

All horizontal duplex fiber optic cable above ceilings should be installed in cable tray or conduit.

All installed horizontal duplex fiber optic cable should pass the testing requirements of ANSI/ANSI/TIA/EIA 568B.

Maximum installed horizontal duplex fiber optic cable length should not exceed 250 feet.

Horizontal duplex fiber optic cable should have no physical defects such as cuts, tears or bulges in the outer jacket. Horizontal duplex fiber optic cable Cables with defects should be replaced.

Install horizontal duplex fiber optic cable in neat and workmanlike manner per the BICSI Installation Manual.

All installed horizontal duplex fiber optic cable should be placed or routed per the manufacturer's recommendations.

7.4 UTP Termination Blocks

Should be installed by the LVLTC on the plywood backboard so that the top of the termination block is 5'6" AFF or in equipment racks as noted on the "T" drawings.

Blocks should be mounted with steel, zinc plated 5/16" - #10 x 3/4" drill screws with a minimum of four screws per block.

The Designer should require the LVLTC to install designation strips color-coded in conformance with ANSI/TIA/EIA 606A standard as follows:

Description	Color
C.O. Circuits	Orange
Common Equipment	Purple
First Level Back Bone Cable	White
Second Level Back Bone Cable	Gray
Horizontal Wiring	Blue
Auxiliary Circuits – Alarms, Security	Yellow
Future use and Key Systems	Red
Inter-building Campus Backbone	Brown

7.5 UTP Patch Panels

The LVLTC should install and label as recommended by manufacturer, per all ANSI/ANSI/TIA/EIA 606.

The Designer should require the LVLTC to install front and rear horizontal cable management as recommended by the manufacturer.

The Designer should require the LVLTC to install ANSI/ANSI/TIA/EIA 606A compliant color-coded icons or color coded designation label strips for all patch panels.

Install UTP patch panels as shown on the "T" drawings.

7.6 Video Termination/Patch Panels

Video termination/patch panels should be installed and terminated in a separate dedicated equipment rack by the LVLTC.

Label as recommended by manufacturer, per all ANSI/ANSI/TIA/EIA 606A.

Front and rear horizontal cable management should be installed as recommended by the manufacturer.

The Designer should require the LVLTC to install ANSI/ANSI/TIA/EIA 606A compliant color-coded icons or color-coded designation label strips for all patch panels.

Install video termination/patch panels as shown on the "T" drawings.

7.7 Fiber Optic Termination/Patch Panels

The LVLTC shall install as shown on the "T" drawings.

The Designer should require the LVLTC to furnish and install labels for each fiber strand, as per as shown on the "T" drawings.

The Designer should require the LVLTC to install blank adapter panels in all positions not used at time of installation for fiber terminations.

Each panel should be labeled as recommended by manufacturer and as per ANSI/ANSI/TIA/EIA 606A.

The Designer should require the LVLTC to install front and rear horizontal cable management as recommended by the manufacturer.

7.8 Video Termination/Patch Panels

Video termination/patch panels should be installed and terminated by the LVLTC in a separate dedicated equipment rack.

Each Panel should be labeled as recommended by manufacturer and as per ANSI/ANSI/TIA/EIA 606A.

Front and rear horizontal cable management should be installed as recommended by the manufacturer.

Install video termination/patch panels as shown on the "T" drawings.

7.0 UTP Connectors

Jacks should be installed by the LVLTC to provide minimal signal impairment by preserving wire pair twists as close as possible to the point of mechanical termination.

The amount of untwisting in a pair as a result of termination to the jack IDC should be no greater 0.5 inches (13 mm)

Jacks should be installed according to manufacturer's instructions and properly mounted in plates, frames, housings or other appropriate mounting device.

Jacks should be installed such that cables terminated to the jacks maintain minimum bend radius of at least 4 times the cable diameter into the work station outlet.

Cables should be terminated on jacks such that there is no tension on the conductors in the termination contacts.

Testing

Jacks should be tested as part of the installed horizontal structured cabling system.

Category 5e and Category 6 Jacks should be tested as per ANSI/ANSI/TIA/EIA 568B as part of the link for Length, DC continuity, NEXT, PSNEXT, Attenuation, Return Loss, ELFEXT, and PSELFEXT using a level III tester (minimum) for Category 5e or Category 6 link compliance.

A "PASS" indication should be obtained for all link or channel tests when tested using the appropriate level tester for the appropriate category.

Level III testers shall be correctly set to test the submitted type of the horizontal cable used in the link, including the correct NVP.

7.10 Video Connectors

Should be installed by the LVLTC as per manufacturer's recommendations

7.11 Fiber Optic Connectors

Connectors should be installed by the LVLTC to provide minimal signal impairment by proper termination techniques.

Connectors should be installed according to manufacturer's instructions and properly mounted in plates, frames, housings or other appropriate mounting device.

Connectors should be installed such that cables terminated to the jacks maintain minimum bend radius of at least 6 times the cable diameter into the work station outlet.

Fibers should be terminated such that there is no tension on the conductors in the termination contacts.

The Designer should require the LVLTC to adhere to all fiber optic cable manufacturers' installation guidelines.

Testing

Fiber Optic cable connectors should be tested using an OTDR.

The Designer should require the LVLTC to follow the OTDR manufacturer's specific instructions for testing the connector and fiber link losses.

Connector should be installed and tested with less than .5 dB of attenuation.

Test Results should conform to ANSI/ANSI/TIA/EIA-526-14A Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant.

7.12 Other Multimedia Connectors

Connectors should be installed by the LVLTC according to manufacturer's instructions and properly mounted in plates, frames, housings or other appropriate mounting device.

7.13 UTP Copper Patch Cords and Cross-Connection Cables

The Designer should require the LVLTC to The LVLTC shall provide to the Agency's representative the quantity of pre-manufactured patch cords / cross-connection cables as stated in the specifications. The Agency's

representative should determine the quantity of patch cords to be provided prior to the specifications being released for bid.

7.14 Fiber Optic Patch Cords

The Designer should require the LVLTC to provide to the Agency's representative with the quantity of pre-manufactured patch cords / cross-connection cables as stated in the final specifications. The Agency's representative should determine the quantity of patch cords to be provided prior to the specifications being released for bid if patch cords are to be provided as part of the project.

8.0 BACKBONE CABLING COMPONENTS

8.1 Multi-pair Copper Cables

The Designer should require the LVLTC to provide 2 days advance notice to the GTA/RCDD prior to installing any cable greater than 400 pairs in size or when a winch is planned for use.

The GTA/RCDD should be present to observe all pulling activities of cable greater than 400 pair or when a winch is planned for use.

Cable bend radius should be maintained to at least 10 times the diameter of the cable.

The LVLTC should be responsible for verifying that conduits are ready for occupancy prior to cable placement.

The LVLTC should assume responsibility for any difficulties or damage to the cable during placement.

Cable feeder guides should be used between the cable reel and the conduit.

Cable should be watched and inspected for sheath defects, as it is spooled off the reel. Pulling operation should be stopped if a defect or any other irregularity is found.

Cable should be spooled off from the top of the reel.

The Designer should require the LVLTC to adhere to all manufacturers' requirements regarding pulling tension, allowable lubricants and the cable's minimum bending radius.

The Designer should require the LVLTC to use a line tension meter during cable pull to provide accurate measurement of the force exerted on a cable as it is installed. The meter should have a programmable overload set point with an audible and visual indication of an overload condition. The meter should have controls to disengage the cable puller if an overload condition occurs. The Designer should require the LVLTC
Provide chart-recorded information of the cable pull for the Agency's records.

The Designer should require the LVLTC to ground and bond all cable shields per the NEC and ANSL/ANSI/TIA/EIA 607.

All cables to should be grounded at both ends with a minimum #6 solid copper insulated green ground wire as required by NEC and ANSI/ANSI/TIA/EIA 607.

The LVLTC should terminate all installed cable pairs as per the "T" drawings.

All cables should be tested in accordance with ANSI/ANSI/TIA/EIA 568B and the results documented on approved test sheets.

All cables should be labeled as per ANSI/ANSI/TIA/EIA 606A.

8.2 Single Mode Fiber Optic Cables

The LVLTC should install fiber optic cable inside a continuous protective plenum innerduct or appropriate sized conduit.

The Designer should require the LVLTC to adhere to all manufacturers' installation instructions.

A minimum service loop of 15 feet should be maintained at all points of termination. Service loops should not be less than manufacturer's recommended bend radius and should be secured and neatly dressed and should not interfere with other cables or termination equipment. An additional 15 feet of coiled, bifurcated, fiber strands should be provided and secured in the termination cabinet as per the cabinet manufacturer's recommendations.

Pulling tensions should not exceed those recommended by the fiber optic cable manufacturer.

The cable manufacturer's minimum specified bend radius should not be exceeded.

The cable shall be sized and installed in accordance with the "T" drawings and specifications.

All fiber optic cable should be installed in conduit or inside an innerduct placed in the cable tray.

The Designer should require the LVLTC to maintain polarization for entire system as described in ANSI/ANSI/TIA/EIA-568B.

The installer should be responsible for verifying that conduits and raceways are "ready for occupancy" before cable placement.

The LVLTC should assume the responsibility for any damage to the cable during placement.

Where fiber optic cable passes vertically through slots and sleeves, The Designer should require the LVLTC to secure the fiber every 18" to the vertical ladder rack.

The fiber optic cable should be labeled as per ANSI/ANSI/TIA/EIA 606A.

Testing

All fiber optic cable strands should be tested using an OTDR.

The Designer should require the LVLTC to follow the OTDR manufacturer's specific instructions for testing all fiber optic cable strands.

Test Results should conform to ANSI/ANSI/TIA/EIA-526-7 Measurements of Optical Power Loss of Installed Single-Mode Fiber Optic Cable Plant.

8.3 Multimode Fiber Optic Backbone Cables

The LVLTC should install fiber optic backbone cable inside a continuous protective plenum innerduct or appropriate sized conduit.

The Designer should require the LVLTC to adhere to all manufacturers' installation instructions.

A minimum service loop of 15 feet should be maintained at all points of termination. Service loops should not be less than manufacturer's recommended cable bend radius and should be secured and neatly dressed and should not interfere with other cables or termination equipment. An additional 15 feet of coiled, bifurcated, fiber strands should be provided in the termination cabinet.

Pulling tensions should not exceed those recommended by the fiber optic cable manufacturer.

Manufacturer's minimum specified bend radius should not be exceeded.

The cable shall be sized and installed in accordance with the “T” drawings and specifications.

All fiber optic cable should be installed in conduit or inside an innerduct placed in the cable tray.

The Designer should require the LVLTC to maintain polarization for entire system as described in ANSI/ANSI/TIA/EIA-568B.

The installer should be responsible for verifying that conduits and raceways are "ready for occupancy" before cable placement.

The LVLTC should assume the responsibility for any damage to the cable during placement.

Where fiber optic cable passes vertically through slots and sleeves, The Designer should require the LVLTC to the cable shall be secured secure the cable every 18" to the vertical ladder rack.

The fiber optic cable should be labeled as per ANSI/ANSI/TIA/EIA 606A.

Testing

All fiber optic cable strands should be tested using an OTDR.

The Designer should require the LVLTC to follow the OTDR manufacturer’s specific instructions for testing all fiber optic cable strands.

Test Results should conform to ANSI/ANSI/TIA/EIA-526-14A Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant.

8.4 Coaxial Video Backbone Cables

All coaxial backbone video cables should be installed by the LVLTC as per the manufacturer’s installation recommendations.

All coaxial backbone video cables shall be installed as shown on the “T” drawings.

All coaxial backbone video cables concealed in walls or soffits should be installed in metal conduits.

All coaxial backbone video cables above ceilings should be installed in cable tray or conduit.

All installed cables should pass the testing requirements of ANSI/ANSI/TIA/EIA 568B.

Coaxial video backbone cables should have no physical defects such as cuts, tears or bulges in the outer jacket. Coaxial backbone video cables with defects should be replaced.

The Designer should require the LVLTC to install coaxial backbone video cables in a neat and workmanlike manner

per the BICSI Installation Manual.

All installed coaxial backbone video cables should be placed or routed per the manufacturer's recommendations.

The Designer should require the LVLTC to maintain the following clearances from EMI sources:

Power - 12 inches
Fluorescent Lights - 12 inches
Transformers - 36 inches

8.5 Single Mode Fiber Optic Backbone Connectors

Connectors should be installed to provide minimal signal impairment by proper termination techniques.

Connectors should be installed according to manufacturer's instructions and properly mounted in plates, frames, housings or other appropriate mounting device.

Connectors should be installed such that cables terminated to the jacks maintain minimum bend radius of at least 6 times the cable diameter into the work station outlet.

Fibers should be terminated such that there is no tension on the conductors in the termination contacts.

The Designer should require the LVLTC to adhere to all fiber optic cable manufacturers' installation guidelines.

The Designer should require the LVLTC to adhere to all fiber optic connector manufacturers' installation guidelines.

Testing

Fiber Optic cable connectors should be tested using an OTDR.

The Designer should require the LVLTC to follow the OTDR manufacturer's specific instructions for testing the connector and fiber link losses.

Connector should be installed and tested with less than .5 dB of attenuation.

Test Results should conform to ANSI/ANSI/TIA/EIA-526-14A Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant.

8.6 Multimode Fiber Optic Backbone Connectors

Connectors should be installed to provide minimal signal impairment by proper termination techniques.

Connectors should be installed according to manufacturer's instructions and properly mounted in plates, frames, housings or other appropriate mounting device.

Connectors should be installed such that cables terminated to the jacks maintain minimum bend radius of at least 6 times the cable diameter into the work station outlet.

Fibers should be terminated such that there is no tension on the conductors in the termination contacts.

The Designer should require the LVLTC to adhere to all fiber optic cable manufacturer installation guidelines.

The Designer should require the LVLTC to adhere to all fiber optic connector manufacturer installation guidelines.

Testing

Fiber Optic cable connectors should be tested using an OTDR.

The Designer should require the LVLTC to follow the OTDR manufacturer's specific instructions for testing the connector and fiber link losses.

Connector should be installed and tested with less than .5 dB of attenuation.

Test Results should conform to ANSI/ANSI/TIA/EIA-526-14A Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant.

8.7 Coaxial Backbone Connectors

The Designer should require the LVLTC to install as per the connector manufacturer's recommendations.

8.8 UTP Termination Blocks - Wall Mounted

The LVLTC should install the blocks on the plywood backboard so that the top of the termination blocks are 5'6" AFF as noted on the "T" drawings.

Blocks should be mounted with steel, zinc plated 5/16" - #10 x 3/4" drill screws with a minimum of four screws per block.

The Designer should require the LVLTC to install designation strips color-coded in conformance with ANSI/TIA/EIA 606A standard as follows:

Description	Color
C.O. Circuits	Orange
Common Equipment	Purple
First Level Back Bone Cable	White
Second Level Back Bone Cable	Gray
Horizontal Wiring	Blue
Auxiliary Circuits – Alarms, Security	Yellow
Future use and Key Systems	Red
Inter-building Campus Backbone	Brown

Label each block in accordance with ANSI/ANSI/TIA/EIA 606A.

8.9 UTP Termination Blocks – Equipment Rack Mounted

The LVLTC should install the blocks in equipment racks as noted on the "T" drawings.

Equipment rack mounted blocks should be mounted per manufacturer's recommendations.

The Designer should require the LVLTC to install designation strips color-coded in conformance with ANSI/TIA/EIA 606A standard as follows:

Description	Color
C.O. Circuits	Orange
Common Equipment	Purple
First Level Back Bone Cable	White
Second Level Back Bone Cable	Gray
Horizontal Wiring	Blue
Auxiliary Circuits – Alarms, Security	Yellow
Future use and Key Systems	Red
Inter-building Campus Backbone	Brown

Label each block in accordance with ANSI/ANSI/TIA/EIA 606A.

8.10 Fiber Optic Termination Cabinets - Wall Mounted

The LVLTC should install the cabinets as per the "T" drawings and the specifications.

Install per the manufacturer's installation instructions.

Should be bonded to ground as required by the NEC.

The Designer should require the LVLTC to install labels as per ANSI/ANSI/TIA/EIA 606A.

The Designer should require the LVLTC to install blank adapter panels in all positions not used at time of installation for fiber terminations.

Install Fiber Optic Termination adapter panels as shown on the "T" drawings.

8.11 Fiber Optic Termination Cabinets - Equipment Rack Mounted

The LVLTC should install the cabinets as per the "T" drawings and the specifications.

The Designer should require the LVLTC to install per the manufacturer's installation instructions.

Should be bonded to ground as required by the NEC.

The Designer should require the LVLTC to install labels as per ANSI/ANSI/TIA/EIA 606A.

The Designer should require the LVLTC to install blank adapter panels in all positions not used at time of installation for fiber terminations.

Install Fiber Optic Termination adapter panels as shown on the "T" drawings.

8.12 Multi-pair Copper Cable Splices

Splicing should only be allowed in manholes or at building entrance locations. No splices should be allowed in any other location in the new facility or in any ducts or innerduct. Splice cases in manholes should be securely supported by support hooks on the cable racks not more than two (2) feet away from the splice case. Before closure, all splices should be offered for inspection.

Encapsulated Closures

The Designer should require the LVLTC to adhere to all manufacturers' installation guidelines.

Support closure at both ends via racks and step, so that no unnecessary stress or weight is applied to the splice case or associated conductors.

End Caps and Closure Extension Sleeves

The Designer should require the LVLTC to adhere to all manufacturers' installation guidelines.

Encapsulants

The Designer should require the LVLTC to adhere to all manufacturers' installation guidelines.

Splicing Tapes

The Designer should require the LVLTC to adhere to all manufacturer usage guidelines.

Gel Stripper

The Designer should require the LVLTC to adhere to all manufacturer usage guidelines.

Bonding and Grounding

The Designer should require the LVLTC to bond the metallic sheath and the splice case to an appropriate ground at all splice locations

The Designer should require the LVLTC to bond the shield of shielded cable to the ground bar in communications rooms and spaces, per applicable code and
manufacturer's recommended practices.

9.0 WORK AREA COMPONENTS

9.1 Flush Wall-mounted Face Plates

Jacks and/or connectors should be installed and terminated by the LVLTC to the appropriate cable and inserted in the correct orientation into the faceplate prior to the mounting of the faceplate.

Sufficient cable slack should be stored behind the faceplate in such a way that allows the manufacturer's specified minimum bend radius of the cables to be maintained.

Care should be taken when mounting the faceplate to avoid crimping or kinking the cables.

Faceplates should be securely mounted to the mounting bracket.

Faceplates should be labeled with the appropriate port designations as per the ANSI/ANSI/TIA/EIA 606A standard.

Unless otherwise noted on the "T" drawings, outlets should be securely and neatly installed at the centered height specified in the following table:

Standard Telephone Outlets:	1ft 6 inches above Finished Floor (AFF)
Wall Mounted Telephone Outlets:	4ft 6 inches AFF

Wall Mounted for Head On Wheelchair Access:	4ft 0 inches AFF
Service Counter Areas:	0ft 8 inches above counter work surface

9.2 Modular Furniture Adapter Plates

Jacks and/or connectors should be terminated and installed by the LVLTC to the appropriate cable and inserted in the correct orientation into the faceplate prior to the mounting of the faceplate.

Sufficient cable slack should be stored behind the faceplate in such a way that allows the manufacturer's specified minimum bend radius of the cables to be maintained.

Care should be taken when mounting the faceplate to avoid crimping or kinking the cables.

Faceplates should be securely mounted to the mounting bracket.

Faceplates should be labeled as per ANSI/ANSI/TIA/EIA 606A standard.

9.3 Floor Box Mounting Frames

Jacks and/or connectors should be installed and terminated by the LVLTC to the appropriate cable and inserted in the correct orientation into the faceplate prior to the mounting of the faceplate.

Sufficient cable slack should be stored behind the faceplate in such a way that allows the manufacturer's specified minimum bend radius of the cables to be maintained.

Care should be taken when mounting the faceplate to avoid crimping or kinking the cables.

Faceplates should be securely mounted to the mounting bracket.

Faceplates should be labeled as per the ANSI/ANSI/TIA/EIA 606A standard.

10.0 ADMINISTRATION AND LABELING

10.1 Backbone Conduit

The Designer should require the LVLTC to permanently secure the tag within 6 inches from both ends of the conduit and at all pull boxes.

Backbone conduits should be labeled with the appropriate designations per the ANSI/ANSI/TIA/EIA 606A standard.

10.2 Backbone Cables

The Designer should require the LVLTC to permanently secure the label within 6 inches from both ends of the cable and in all pull boxes.

Should be labeled with the appropriate designations per the ANSI/ANSI/TIA/EIA 606A standard.

Labels should indicate origination and destination Telecommunication Room ID sheath ID and strand or pair range.

10.3 Horizontal Cables

Horizontal cables should be marked at each end of the sheath indicating the Telecommunication Room, patch panel and panel port to which the horizontal cable is terminated.

The Designer should require the LVLTC to permanently secure the label within 6 inches from both ends of the cable and at all pull boxes.

Should be labeled with the appropriate designations per the ANSI/ANSI/TIA/EIA 606A standard.

10.4 Riser Conduits

The Designer should require the LVLTC to permanently secure the tag within 6 inches from both ends of the conduit and at all pull boxes.

Should be labeled with the appropriate designations per the ANSI/ANSI/TIA/EIA 606A standard.

10.5 Cable Trays

The Designer should require the LVLTC to permanently secure the labels on both sides of the cable tray at 10 foot intervals and at both ends of the cable tray.

Cable trays should be labeled with the appropriate designations per the ANSI/ANSI/TIA/EIA 606A standard.

10.6 Equipment Bonding Conductor

The Designer should require the LVLTC to permanently secure the tag within 6 inches from both ends of the Equipment bonding conductor.

Should be labeled with the appropriate designations per the ANSI/ANSI/TIA/EIA 606A standard.

10.7 Service Entrance Conduits

The Designer should require the LVLTC to permanently secure the tag within 6 inches from both ends of the entrance conduit and at all access points.

Should be labeled with the appropriate designations per the ANSI/ANSI/TIA/EIA 606A standard.

10.8 Telecommunications Spaces

Should be labeled per the Architects instructions.

10.9 Telecommunications Grounding Busbar

The Designer should require the LVLTC to permanently secure the label within six inches of the busbar.

Should be labeled with the appropriate designations per the ANSI/ANSI/TIA/EIA 606A standard.

10.10 Equipment Racks and Cabinets

The Designer should require the LVLTC to permanently secure the labels to the top center portion of the front of the rack/cabinet.

Should be labeled with the appropriate designations per the ANSI/ANSI/TIA/EIA 606A standard.

10.11 Patch Panels

UTP patch panels should be labeled as shown on the drawings, individual ports should come labeled from the factory with a number designation.

Fiber optic cables should be labeled as shown on the drawings; individual ports should come labeled from the factory with a number designation.

The Designer should require the LVLTC to permanently secure the label to the patch panel.

Should be labeled with the appropriate designations per the ANSI/ANSI/TIA/EIA 606A standard.

10.12 UTP Terminations Blocks

The Designer should require the LVLTC to permanently secure the label to the UTP termination block.

Individual ports should be labeled as shown on the drawings.

Should be labeled with the appropriate designations per the ANSI/ANSI/TIA/EIA 606A standard.

10.13 Pull Boxes

The Designer should require the LVLTC to permanently mark all pull boxes on the cover and the side of the pull box.

Should be labeled with the appropriate designations per the ANSI/ANSI/TIA/EIA 606A standard.

10.14 Splices

The Designer should require the LVLTC to permanently secure the tag to the splice case.

Should be labeled with the appropriate designations per the ANSI/ANSI/TIA/EIA 606A standard.

10.15 Telecommunications Main Grounding Busbar

The Designer should require the LVLTC to permanently secure the label to the wall within 6 inches of the main grounding busbar.

Should be labeled with the appropriate designations per the ANSI/ANSI/TIA/EIA 606A standard.

10.16 Work Area Outlets

Copper cables terminated in a work area outlet should be labeled, as shown on the drawings and to indicate the following: Telecommunication Room, patch panel and panel port to which the cable is terminated for each cable that it houses.

Fiber optic cables terminated in a work area outlet should be labeled, as shown on the drawings and to indicate the following: the origination and destination Telecommunication Room's and the individual strand ID.

The Designer should require the LVLTC to permanently secure the label to the work area outlet.

Should be labeled with the appropriate designations per the ANSI/ ANSI/TIA/EIA 606A standard.

C. CUSTOMER OWNED OSP/INTERBUILDING

1.0 CONDUIT AND INNERDUCT

1.1 General

Generally speaking, all trenching and duct bank installation should be the responsibility of the General Contractor and/or the Electrical Contractor. The LVLTC should not be required to trench or install OSP conduit or duct bank. The Architect is reminded, however, that GSFIC prohibits the Architect from apportioning the work. Who performs what work remains the decision of the General Contractor, so long as the installer is qualified to perform those duties.

1.2 Preparatory Work

In general, The Designer should require the LVLTC to:

- The contractor shall build lines to grade and elevations as shown on the "T" drawings.
- Provide stakes, grade boards, cleats, nails, instruments. Locate and stake each new run for its entire length.
- Verify elevations given.
- Start excavation at low point.
- Notify the Engineer of elevation discrepancies.
- Protect marks and stations.
- Before excavating work, coordinate with Owner's Site Representative and other trades.
- Furnish schedule of operations to Owner and each trade.
- Provide and maintain temporary bridges, walks and bridges over excavations where underground utility lines, sewers, water lines, etc., cross access roads, walks, and streets.

Make necessary arrangement with authorities having jurisdiction. Provide the services of a Licensed Surveyor for layout of the following:

Examine substrates, areas and conditions, with the installer present, for compliance with requirements for installation tolerances and other conditions affecting installation. Installation should not proceed until unsatisfactory conditions have been corrected.

1.3 Protection

The Designer should require the LVLTC to:

- Provide bracing, shoring, sheathing and other work for: protection of personnel, the contract work, excavations, trees, shrubs, existing structures, and surrounding properties.
- Slope sides of excavations to comply with local codes and ordinances.
- Provide, erect, and maintain barricades, warning signs, flags, and lights to provide protection for work, workmen, public, and property.
- Plank walks, pavements, and curbs to be crossed by equipment.

- Protect adjacent property, existing fences, trees, shrubs, roads, curbs, sidewalks, manholes, hydrants, and other items

- Restore, repair, rebuild or replace any such items damaged or destroyed to condition equal to that existing before such damage occurred.

- Establish conditions, before starting work, by taking photographs to determine state to which existing conditions must be restored. Submit such photographs notarized, identified and dated for record.

1.4 Existing Utilities

Every attempt should be made to indicate existing utilities as accurately as possible from existing drawings, surveys, and data.

The Designer should require the LVLTC to:

- Report immediately other utility lines encountered, but not shown on the drawings.
- Notify the Underground Facilities Protection Organization (UFPO), where same exists, before starting work.
- Verify exact location of existing utility lines where work crosses existing utilities and where connections are to be made by test hole before starting work.
- Notify utility companies, municipalities, owner organizations, and other involved jurisdictions when excavation occurs within vicinity of existing underground service such as sewers, water, electric, gas, telephone, including such services owned by the agency.
- If existing service lines, utilities and utility structures which are to remain in service are uncovered or encountered during this excavation, they should be protected from damage, and securely supported as directed and approved by the involved jurisdiction..
- Immediately report damage or injury to utility lines to Owner's Representative and involved jurisdiction. Repair or replace utility lines damaged or injured as directed and approved by the involved jurisdiction. Excavate by hand in proximity to existing underground utility lines; take extreme care when excavating around ductbanks carrying energized cable.

Remove plug or cap inactive or abandoned utilities encountered during construction operations. The location of such utilities should be noted on the as-built drawings.

1.5 Cutting and Patching

The Designer should require the LVLTC to:

- Before starting work, obtain necessary permits and pay fees and charges for same.
- Cut paved areas as called for, perpendicular to surface and in straight saw-cut lines.

Replace pavements, roadways, streets, blacktop areas, walks, disturbed by excavating operations with materials equal to adjacent pavements.

1.6 Methods

The Designer should require the LVLTC to:

- Provide for buried work in contract both inside and outside of building.
- Excavate to proper depth and width for installation work as called for.
- Remove materials including masonry work, rubble, earth, brickwork, concrete, sand, debris, abandoned pipe lines, drains and sewers, rocks, boulders, and concrete, all of which is considered "earth excavation."
- Provide for legal disposition of excess excavated materials.

- Make allowance for gravel fill, sand bases, form work, floor slabs, manholes, anchor and thrust blocks, sheet piping, drainage pumps, and work space.

Start excavation at rough grade and provide form work and sheet piling where required.

1.07 Trench excavation:

The Designer should require the LVLTC to:
By open cut, to proper depth and grade no wider than required for placement of work and not more than 100 ft. in advance of utility being installed.

- Should trench bottom be wet, unstable, and/or otherwise incapable of supporting the contract work, immediately report same to Owner' Representative.

Should it be deemed unsuitable, excavate to depth as directed and back fill with gravel to trench depth, or provide concrete cradling.

Should rock be encountered, excavate 6 in. deeper and fill space between trench bottom and pipe with coarse sand, well tamped to form firm bed.

1.08 Shoring, bracing, sheathing:

The Designer should require the LVLTC to:

- In addition to governing codes, protect sides of excavations with sheeting and bracing where necessary to prevent sliding or caving of banks and to protect adjacent structures.

Remove as back fill is placed.
Provide at locations adjacent to existing manholes, hydrants, and similar items.

1.09 Backfill

The Designer should require the LVLTC to:
Provide bedding around conduit with coarse sand from 6 in. below to 8 in. above. Apply by hand and compact under and at sides by mechanical means

Conduits and sand bed must be inspected and tested prior to backfill of any nature. Provide necessary anchors, thrust blocks, for testing.

Fill remainder of trench in 12 in. layers, use ordinary fill material, except as otherwise specified. Do not use frozen material. Remove boulders, stones, broken rock, wood, bricks, blocks, and debris from fill material before backfill operation.

Under roadways, manholes, drives, parking areas, walks, slabs, on grade and at utility entrance to building provide backfill in 6 in. layers with gravel or crushed stone, free from organic or other unsuitable material, to grade.

Thoroughly compact each layer.

Compaction to not less than 95% density compared to maximum laboratory tests by weight, per modified ASTM D1557-64T, latest editions, method "A" under slab on grade, roadways, drives, and other paved areas and 85% for general grading.

1.10 Removal of water

The Designer should require the LVLTC to:

- Provide pumps, hoses, pipe, labor and fuel, necessary to keep excavations free of water accumulation. Maintain and operate equipment.

- Discharge water in manner not interfering with any trade's work and not to undermine or disturb existing or adjacent structures or land.

Grade to prevent surface water from flowing into all excavations and trenches. Do not discharge dirt, backfill, debris, into sanitary or storm drainage systems.

1.11 Rock Excavation

Rock Excavation defined as:
Ledge rock requiring blasting or air hammer for removal.

Boulders in excess of 1-1/2 cu. yards in size. Demonstrate that material in question cannot be removed with a 1-1/2 yd. backhoe or shovel. Rock excavation is defined in the General Conditions.

1.12 Blasting:

Should rock be encountered which cannot be removed with a 3/4 cu. yd. capacity power shovel without drilling and blasting, blasting should be done by a licensed blasting contractor. Work should be accomplished entirely at the Contractor's risk and he should accept liability for resultant damage. The transportation, handling, storage, and the use of explosives should be performed in accordance with the provisions of local and state laws and authorities having jurisdiction. Blasting is generally prohibited in the General Conditions. Architects should confer with the Owner if Blasting is anticipated to be necessary to obtain appropriate language in accordance with ANSI A10.2.

1.13 Job completion

The Designer should require the LVLTC to:

1) On completion of the work, clean the entire site; remove surplus earth, large stones and debris, to off-site legal disposal. Remove tools and equipment and leave the entire area in a neat condition.

2) Rough grade to 6 in. below finished grade. Scarify subsoil to depth of 2 In. to achieve bond between topsoil and subsoil.

3) Repave, re-seed and completely restore the area to the condition prior to the start of excavation and trenching work.

1.14 Four-Inch Non-Metallic Conduit (Schedule 40 PVC)

The Designer should require the LVLTC to:
Install spacers in between all conduits being installed.

Cement conduits and fittings in a manner that will allow a water tight seal.

Encase all conduits in concrete.

The minimum depth to the top of the highest conduit is 36 inches.

Conduits should be sloped (minimum 1% every hundred feet) away from all access points and the building.

Provide a ½ inch high strength foot-marked conduit measuring tape inside each conduit, and secure at each access point.

Seal all conduits using manufactured duct and conduit plugs/seals to prevent moisture, gas and rodents from entering at both ends of the conduit.

1.15 Four-inch, Galvanized, Rigid-steel Conduit

The Designer should require the LVLTC to:
Install spacers in between all conduits being installed.

Connect conduits and fittings in a manner that will allow a water tight seal.

Encase all conduits in concrete.

The minimum depth to the top of the highest conduit is 36 inches.

Conduits should be sloped (minimum 1% every hundred feet) away from all access points and the building.

Provide a ½ inch high strength foot-marked conduit measuring tape inside each conduit, and secure at each access point.

Seal all conduits using manufactured duct and conduit plugs/seals to prevent moisture, gas and rodents from entering at both ends of the conduit.

1.16 Corrugated Innerduct

The Designer should require the LVLTC to:
Install three 1.25 inch corrugated innerducts in all 4-inch conduits.

Provide a ½ inch high strength foot-marked conduit measuring tape inside each corrugated innerducts and secure at each access point.

2.0 MAINTENANCE HOLES and HANDHOLES

2.1 Maintenance Holes

Install maintenance hole as shown on the "T" drawings and the specifications.

Minimum strength in concrete compression requirement should be 6000 PSI.

All conduits should be installed to enter and exit on two opposite pre-cored end walls only.

Conduits should enter manholes in a splayed vertically stacked design 9 inches from the corner of the side walls and be terminated with bell ends.

At no time should conduits enter on the sidewall of the manholes. Conduits should be installed into the pre-cored knockouts starting on the bottom to allow for future expansion from the top.

The location of the maintenance hole cover layout and other details should be shown on drawings and should be clear of reinforcement bars.

Pulling eyes or iron opening should be installed in the manholes per manufacturer specifications.

The Designer should require the LVLTC to install cable racks, pulling irons, sump holes, frames, and covers.

The Designer should require the LVLTC to install PVC water barrier at each construction joint.

Standard hardware required for construction and utilization of manholes should be installed. This includes rocking bolt assemblies, vertical support brackets, pulling irons, ladder support hooks, etc.

Maximum installed distances between manholes should not be greater than 400 feet for a run containing an aggregate of 45-degree bend, and 200 feet for runs having an aggregate of 90-degree bend.

Telecommunications manholes should not be adjacent to nor share any walls with electrical manholes.

Interiors

All materials used in a manhole should be resistant to corrosion. All steel should be galvanized or zinc coated.

The Designer should require the LVLTC to install maintenance hole racking equipment and cable supports as required. All racks in manholes should be galvanized or zinc coated

Install cast-iron steps for climbing in and out of the maintenance hole.

All conduits entering a maintenance hole should be sealed from the outside of the maintenance hole prior to backfilling.

All concrete joints in manholes are required should be required to be watertight.

2.2 Handholes

The Designer should require the LVLTC to:
Install handhole as shown on the "T" drawings and per the specifications.

Install 6 inches of gravel in the bottom of every handhole.

Install top of the handhole flush with the finished grade.

Racking system should be installed per the manufacturer's instructions.

All conduits entering a handhole should be sealed from the outside of the handhole prior to backfilling.

3.0 GROUNDING AND BONDING

3.1 Aerial

Ground and bond per RUS requirements and ANSI/ANSI/TIA/EIA 758.

3.2 Underground

Ground and bond per RUS requirements and ANSI/ANSI/TIA/EIA 758.

4.0 AERIAL SUPPORT

4.1 Utility Poles

The electrical contractor shall install Class 5 poles as shown on the "T" drawings and as per RUS requirements.

The Designer should require the LVLTC to label as per RUS requirements and ANSI/ANSI/TIA/EIA 606A.

4.2 Messenger and Guying Strand

Install 3/16" diameter 7-wire galvanized "6M" steel messenger strand as shown on the "T" drawings.

The Designer should require the LVLTC to:
Install all strand to meet RUS requirements.

Install utilities grade strand, having a minimum breaking strength of 5,500 pounds, having a left lay and at least an "A" rated galvanized coating weight.

Strand Connectors

The Designer should require the LVLTC to install all B strand connectors, suspension/cable clamps, grounding tap clamps, hangers, 1-bolt and 3-bolt clamps to adequately support the strand as typically indicated.

4.3 Galvanized Steel Attachment Hardware

The Designer should require the LVLTC to:
Install the appropriate S guy bolts, wall straps, brackets, etc., as necessary to adequately support the strand as indicated on the "T" drawings.

Install S guy bolts (or commonly called anchor rods or thimble-eye bolts) with a minimum 5/8" diameter to attach messenger strand deadends. The bolt length should be at least 4" longer than the width of the pole to which it will be attached.

4.4 Lashing Wire

The Designer should require the LVLTC to:
Install stainless steel type 430 lashing wire with .045" minimum diameter.

Connect lashing wire to messenger strand using strand clamps.

4.5 Grounding Apparatus

The Designer should require the LVLTC to ground and bond all poles, messenger strand and any other metallic parts in accordance with RUS, the NESC and ANSI/ANSI/TIA/EIA 607.

4.6 Guying Apparatus and Anchors

Guying Strand

Install strand apparatus as shown on the "T" drawings and the specifications.

The Designer should require the LVLTC to:
Install guying apparatus per RUS.

Install yellow protective guard on all down guys.

Anchor

The Designer should require the LVLTC to:
Install eight ways anchor designed for installation which includes a ¾" thimble eye bolt.

Install one piece top plate that expands upon impact into undisturbed earth to form a cone shaped square to distribute the anchors holding power over a wide area.

5.0 BACKBONE CABLING

5.1 Multi-pair Copper Cables

Installer should provide 2 days advance notice prior to pulling any cable greater than 400 pairs in size or when a winch is planned for use.

Installer should be present to observe all pulling activities of cable greater than 400 pair or when a winch is planed for use.

Cable bend radius should be at least 10 times the diameter of the cable.

Installer should be responsible for verifying that conduits are ready for occupancy prior to cable placement.

Installer should assume responsibility for any difficulties or damage to the cable during placement.

Cable feeder guides should be used between the cable reel and the conduit.

Cable should be watched and inspected for sheath defects, as it is spooled off the reel. Pulling operation should be stopped if a defect or any other irregularity is found.

Cable should be spooled off from the top of the reel.

The Designer should require the LVLTC to adhere to all manufacturers requirements regarding pulling tension allowable lubricants and bending radius.

The Designer should require the LVLTC to use Line Tension meter during cable pull to provide accurate measurement of the force exerted on a cable as it is installed. The meter should have a programmable overload set point with an audible and visual indication of an overload condition. The meter should have controls to disengage the cable puller if an overload condition occurs.

The Designer should require the LVLTC to provide chart-recorded information of the cable pull for the Agency's records.

The Designer should require the LVLTC to ground and bond all cable shields per the NEC.

All cables to should be grounded at each end with a minimum #6 solid copper insulated green ground wire as required by NEC and ANSI/ANSI/TIA/EIA 607.

Terminate all installed cable pairs per the "T" drawings.

All cables should be tested and the results documented on approved test sheets.

All cables should be labeled as specified on the “T” drawings and as per ANSI/ANSI/TIA/EIA 606A.

5.2 Fiber Optic Cables

The LVLTC should install fiber optic cable inside a continuous protective PVC innerduct.

The Designer should require the LVLTC to adhere to all manufacturers’ installation instructions.

The Designer should require the LVLTC to install a minimum service loop of 25 feet should be maintained at all access points. Service loops should not be less than manufacturer's recommended bend radius and should be secured and neatly dressed and should not interfere with other cables.

Pulling tensions should not exceed those recommended by the fiber optic cable manufacturer.

Manufacturer's minimum specified bend radius should not be exceeded.

Shall be sized in accordance with the “T” drawings and specifications.

The Designer should require the LVLTC to install all fiber optic cable inside an innerduct.

Maintain polarization for entire system as described in ANSI/ANSI/TIA/EIA-568B.

The installer should be responsible for verifying that conduits and raceways are "ready for occupancy" before cable placement.

The installer should assume the responsibility for any damage to the cable during placement.

The fiber optic cable should be labeled as indicated on the “T” drawings and per ANSI/ANSI/TIA/EIA 606A.

Where provided attach fiber optic cables to the racking system inside all handholes and maintenance holes.

Testing

All fiber optic cable strands should be tested using an OTDR.

The Designer should require the LVLTC to follow the OTDR manufacturer’s specific instructions for testing all fiber optic cable strands.

5.3 Coaxial Video Cables

All coaxial backbone video cables should be installed by the LVLTC as per the manufacturer’s installation recommendations.

All coaxial backbone video cables should be installed as shown on the “T” drawings.

All installed cables should meet or exceed the requirements of ANSI/ANSI/TIA/EIA 568B.

Coaxial video backbone cables should have no physical defects such as cuts, tears or bulges in the outer jacket. Coaxial backbone video cables with defects should be replaced.

The Designer should require the LVLTC to install coaxial backbone video cables in a neat and workmanlike manner

per the BICSI Installation Manual.

All installed coaxial backbone video cables should be placed or routed per the manufacturer's recommendations.

Where provided attach coaxial backbone video cables to the racking system inside all handholes and maintenance holes.

5.4 Copper Cable Splice Cases

Encapsulated Closures

The Designer should require the LVLTC to adhere to all manufacturers' installation guidelines.

Support closure at both ends via racks and step, so that no unnecessary stress or weight is applied to the splice case or associated conductors.

End Caps and Closure Extension Sleeves

The Designer should require the LVLTC to adhere to all manufacturers' installation guidelines.

Encapsulants

The Designer should require the LVLTC to adhere to all manufacturers' installation guidelines.

Splicing Tapes

The Designer should require the LVLTC to adhere to all manufacturer usage guidelines.

Gel Stripper

The Designer should require the LVLTC to adhere to all manufacturer usage guidelines.

Bonding and Grounding

The Designer should require the LVLTC to:
Bond the metallic sheath and the splice case to an appropriate ground at all splice locations

Bond the shield of shielded cable to the ground bar in communications rooms and spaces, per applicable code and manufacturer's recommended practices.

5.5 Fiber Optic Cable Splice Cases

The Designer should require the LVLTC to install splice cases as indicated on the "T" drawings.

Install per the manufacturer's installation instructions.

Bond to ground as required by the NEC.

6.0 ADMINISTRATION AND LABELING

6.1 Backbone Conduits

The Designer should require the LVLTC to:
Permanently secure the tag within 6 inches from both ends of the entrance conduit and at all access points.

Label with the appropriate designations per the ANSI/ANSI/TIA/EIA 606A standard.

6.2 Telecommunications Bonding Conductors

The Designer should require the LVLTC to:
Permanently secure the tag within 6 inches from both ends of the Equipment bonding conductor.

Label with the appropriate designations per the ANSI/ANSI/TIA/EIA 606A standard.

6.3 Service Entrance Conduits

The Designer should require the LVLTC to:
Permanently secure the tag within 6 inches from both ends of the entrance conduit and at all access points.

Label with the appropriate designations per the ANSI/ANSI/TIA/EIA 606A standard.

6.4 Backbone Cables

The Designer should require the LVLTC to:
Permanently secure the label within 6 inches from both ends of the cable and in all pull boxes.

Label with the appropriate designations per the ANSI/ANSI/TIA/EIA 606A standard.

6.5 Handholes

The Designer should require the LVLTC to:
Install the handhole cover labeled “Telephone”, “Communications”, "Signal" or “CATV” cast in 2” high lettering on the cover.

Install a minimum three-inch square surface area tag, mechanically stamped, legible and permanently affixed.

Acceptable tagging materials are copper, brass or 1/16 inch plastic.

Label with the appropriate designations per the ANSI/ANSI/TIA/EIA 606A standard.

6.6 Maintenance Holes

The Designer should require the LVLTC to:
Install the maintenance hole cover labeled “Telephone”, “Communications”, "Signal" or “CATV” cast in 2” high lettering on the cover.

Install a minimum three-inch square surface area tag, mechanically stamped, legible and permanently affixed.

Acceptable tagging materials are copper, brass or 1/16 inch plastic.

Label with the appropriate designations per the ANSI/ANSI/TIA/EIA 606A standard.

6.7 Utility Poles

The Designer should require the LVLTC to:
Install a minimum three-inch square surface area tag, mechanically stamped, legible and permanently affixed.

Acceptable tagging materials are copper, brass or 1/16 inch plastic.

Label with the appropriate designations per the ANSI/ANSI/TIA/EIA 606A standard.

6.8 Splices

The Designer should require the LVLTC to"
Install a minimum three-inch square surface area tag, mechanically stamped, legible and permanently affixed.

Acceptable tagging materials are copper, brass or 1/16 inch plastic.

- Label with the appropriate designations per the ANSI/ANSI/TIA/EIA 606A standard.

APPENDIX A- Glossary of Cabling and Telecommunications Terms and Concepts

AEC – Architects, Engineers, and Consultants.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) - ANSI is the umbrella organization in the United States for the repository and definition of standards. ANSI represents the U.S. in the International Standards Organization (ISO).

AMERICAN WIRE GAUGE (AWG) - The standard gauge for measuring the diameter of copper, aluminum, and other conductors.

ANSI/EIA/TIA 568 - Approved in 1991, this document specifies the standards for commercial building telecommunications wiring in North America. The standard specifically addresses the type of wiring to use, wiring practices, terminations and connections, and cable performance standards. The current version of this standard is 568-B (April 2002).

ANSI/EIA/TIA 569 - North American commercial building standard for telecommunications pathways and spaces. Its purpose is to standardize specific design and construction practices within and between buildings which are in support of telecommunications media and equipment. The current version of this standard is 569-A.

ASYNCHRONOUS TRANSFER MODE (ATM) - A high speed cell-based switching and multiplexing technology based on segmentation of voice, data and video into fixed packets (cells).

ATTENUATION - A reduction in strength or deterioration of an electrical signal as it passes through a transmission medium. Attenuation generally increases with frequency, cable length and the number of connections in a circuit. Attenuation is measured in decibels (dB). In optical fiber, a diminution of the signal as a function of length traveled.

AUTOTEST - A pre-programmed series of tests and pass/fail criteria used by a hand-held cable test device to determine and certify the category of performance of data cabling.

BACKBONE - The part of a premises distribution system that carries the heaviest traffic. Includes a main cable route and facilities for supporting the cable from the MC to IC, IC to HC, or ER to MC, IC, or TR.

BANDWIDTH - In electrical transmission systems, the range between the highest and lowest frequencies of a transmission channel. A measure of the information capacity of the transmission channel. The measured difference at some Frequency between Cross-talk and Attenuation. Bandwidth varies with the type and method of transmission. Bandwidth is measured in Hertz.

BARRIER - A permanent partition installed in a cable raceway or housing that provides complete separation of the adjacent compartment.

BASEBAND - A network in which the entire bandwidth of the transmission medium is used as a single digital signal.

BEND RADIUS - The radius a cable can bend before the risk of breakage or increase in attenuation occurs. Or, the allowable radius a cable can be bent per a particular Standard.

BER - Bit Error Rate is calculated as follows: The data packet sent, minus the data packet received, divided by the data packet transmitted.

BICSI - Building Industry Consulting Services International. BICSI, a not-for-profit telecommunications association, is a world-wide resource for technical publications, training, conferences, and registration programs for low-voltage cabling distribution design and installation. BICSI has over 20,000 members residing in 85 nations.

BIT - A contraction of the term binary digit. A bit can be either 0 or 1 and is the smallest possible unit of information in digital code.

BIT/S (BPS) - Bits per second. A measure of speed or data rate. Often combined with metric prefixes such as Kbps (kilo or thousands of bits per second) and Mbps (mega or millions of bits per second).

BNC - A bayonet-locking connector used to terminate coaxial cables. There is some disagreement as to whether BNC is an acronym for Bayonet-Neill-Concelman or Bayonet Nut Coupler.

BONDING - The permanent joining of metallic parts to form an electrically conductive path that will assure electrical continuity and the capacity to conduct safely any current likely to be imposed on it.

BROADBAND - A network in which the bandwidth can be shared by multiple simultaneous signals that are encoded with radio frequency modulations.

BUFFER COATING - Protective material applied to optical fibers.

BUILDING ENTRANCE AREA - The area inside a building where telecommunications cables enter and leave (see Telecommunications Entrance).

BUS - 1) A data path shared by many devices. 2) A linear network topology in which all workstations are connected to a single cable. On a bus network, such as Ethernet, all workstations receive all transmissions; only the workstation that the information is addressed to will use the information. contrast with ring and star.

BYTE - A collection of bits operated upon as a unit, usually 8 bits long. Often used to represent one character. Also used to measure the capacity of storage devices.

CABLE TESTER - A handheld electronic device that is used to measure the electrical and physical properties of network cabling. Used commonly to certify cabling to known standards, or as a troubleshooting tool.

CAMPUS - A premises containing more than one building adjacent or near to one another.

CAMPUS BACKBONE CABLE - The communications cable that is part of the Campus Backbone Subsystem and that is placed between buildings. There are four methods of installing campus backbone cable: in-conduit (in underground conduit), direct-burial (in trenches), aerial (on poles), and in-tunnel (in steam tunnels).

CAPACITANCE - The property of a system of conductors and dielectrics that permits the storage of electrically separated charges when potential differences exist between the conductors.

CATEGORY OF PERFORMANCE – Copper cable and connector hardware components, as well as link and channels, are rated to performance categories as defined by ANSI/TIA/EIA. As of April 2002, the ANSI/ANSI/TIA/EIA 568-B Commercial Building Telecommunications Cabling Standard defines only two categories of performance for new construction: Category 5e and Category 3. Category 6 is expected to be published sometime later in 2002 or 2003. For Category 5e, acceptable electricals for the components and link & channel are defined for frequencies up to and including 100 MHz, and no farther. For Category 3, those electricals are defined for frequencies up to and including 16 MHz.

CATV (COMMUNITY ANTENNA TELEVISION) - A method of delivering high quality television reception by transmitting signals from a central antenna throughout the community via coaxial cable. CATV is a broadband transmission facility which generally uses a 75W coaxial cable to carry numerous frequency-divided TV channels simultaneously.

CCTV (CLOSED CIRCUIT TELEVISION) - In general, a video channel which is broadcast to a limited number of locations. Often used in security applications.

CHANNEL – The end-to-end transmission path from equipment cord end in the TR to the patch cord end in the WA. Per ANSI/ANSI/TIA/EIA 568-B.2-1 (pending) the Channel includes up to 328' of horizontal cable; a work area cord; a telecommunications outlet or connector; an optional transition point or consolidation connector; and two connection

(cross-connect) connected by a patch cord and an equipment cord in the telecommunications room. When a maximum horizontal length of 328' is used, then the total length of the equipment cord, patch cord and work area cord should not exceed 33'.

CHARACTERISTIC IMPEDANCE - The impedance that an infinitely long transmission line would have at its input terminal. If a transmission line is terminated in its characteristic impedance, it will appear (electrically) to be infinitely long, thus minimizing signal reflections from the end of the line.

CIRCUIT - 1) (Communications) A bi-directional communications path between two pieces of associated equipment. 2) (Power) An arrangement of conductors, devices and utilization equipment (loads) such that current will pass through them.

CLADDING - The material surrounding the core of a fiber optic cable. The cladding must have a lower index of refraction than the core in order to contain the light in the core.

CLOSED ARCHITECTURE - An architecture that is compatible only with hardware and software from a single vendor. Contrast with Open Architecture.

COAXIAL CABLE - A type of communication transmission cable in which a solid center conductor is surrounded by an insulating spacer which in turn is surrounded by a tubular outer conductor (usually a braid, foil or both). The entire assembly is then covered with an insulating and protective outer layer. Coaxial cables have a wide bandwidth and can carry many data, voice and video conversations simultaneously. Commonly used for Cable TV (CATV) or older computer networks.

CONDUIT - A rigid or flexible metallic or nonmetallic raceway of circular cross section in which cables are housed for protection and to prevent burning cable from spreading flames or smoke in the event of a fire.

CONNECTOR – A device that connects wire or fiber in cable to equipment, other wires or fibers.

CONNECTING BLOCK - A plastic block that houses metal wiring terminals to provide a connection between two groups of wires. Connecting blocks have Insulation Displacement Connectors so insulation removed prior to termination is not required. Major block types are 110 and 66.

CONSOLIDATION POINT - An interconnection between horizontal cables that extends from building pathways to the work area, typically used to support frequent rearrangement of open office furniture clusters.

CORE - The central region of an optical fiber through which light is transmitted.

CROSS CONNECT - A facility enabling the termination of cable elements and their interconnection and/or cross-connection, primarily by means of a patch cord or jumper.

CROSS CONNECTION - A connection scheme between cabling runs, subsystems, and equipment using patch cords or jumpers that attach to connecting hardware on each end.

CROSSTALK - The phenomenon in which a signal transmitted on one circuit or channel of a transmission system creates an unwanted signal in another circuit or channel, generally related to wire placement, shielding, and transmission techniques. Crosstalk interferes with the desired data signal. The level of unwanted crosstalk in network cabling can be determined by the use of handheld testers.

DECIBEL (DB) - A unit for measuring the relative strength of a signal. Usually expressed as the logarithmic ratio of the strength of a transmitted signal to the strength of the original signal. A 3 dB increase in signal strength is twice the original signal. A 3 dB decrease is half the original signal.

DELAY - In data communications, the time between transmission and reception of a signal. Usually expressed in nanoseconds. Also see Propagation Delay.

DELAY SKEW - The difference in time between the arrival (reception) of a data signal and subsequent related data signals. Usually expressed in nanoseconds.

DROP CABLE - The cable which allows connection and access to and from the trunk cables of a network such as the cables that connect individual PCs to the bus on a bus LAN.

DEMARCATION - A point at which two services may interface and identify the division of responsibility, such as the point of interconnection between telephone company facilities and the user's terminal equipment.

DUAL DUPLEX - Simultaneous bi-directional transmission over the same wire pair.

EIA (ELECTRONIC INDUSTRIES ASSOCIATION) - A consultative group of manufacturers recognized as the standards writing group in the United States for electronic equipment.

ELFEXT - Equal Level Far End Crosstalk; a measure of the unwanted signal coupling, expressed in dB relative to the received (attenuated) signal level, from a transmitter at the far end into the neighboring pairs measured at the near end. Characterizing ELFEXT is important for cabling links intended to support 4 pair, full-duplex network transmissions.

EMI/RFI (ELECTROMAGNETIC INTERFERENCE/RADIO FREQUENCY INTERFERENCE) - The interference in signal transmission or reception resulting from the radiation of undesirable electrical or magnetic fields.

ENTRANCE FACILITY - The Entrance Facility is an entrance to the building for both public and private network service cables, including the entrance point at the building wall and continuing to the entrance room or space.

EQUIPMENT ROOM (ER) - An Equipment Room is a centralized space for housing telecommunications equipment. It is differentiated from the Telecommunications Room by the type of equipment used and the room serves a building or multiple buildings in a campus environment.

ETHERNET - A baseband local area network used for connecting computers and terminals, etc., within the same building. Ethernet was marketed (and trademarked) by Xerox and developed jointly by Digital Equipment Corporation, Intel and Xerox. It is the basis for the IEEE Standard 802.3. It employs CSMA/CD as the network access method, and is popularly deployed as 10BASET, 100BASET, and 1000BASET, where 10, 100, or 1000 is the data transfer rate in megabits/second, BASE indicates Baseband transmission, and T signifies Twisted Pair as the medium.

FAR END CROSSTALK (FEXT) - Measure of unwanted signal coupling from a transmitter at the far end into neighboring pairs measured at the near end.

FERRULE - A component of a fiber optic connection that aligns and protects the stripped end of a fiber.

FIBER LOSS (Optical Loss) - The attenuation (decrease) of the light signal in optical fiber transmission. Optical loss is directly related to the length of fiber and the quality and number of connections and splices in a fiber segment.

FIBER OPTICS - The technology in which communication signals in the form of modulated light beams are transmitted over a glass or plastic fiber transmission medium, and then demodulated to electrical signals by a light sensitive receiver.

FIRE-RATED POKE-THROUGH - A cable distribution device which is fitted through a pre-drilled core hole in the floor and allows cables to be fed from the floor below.

FLOOR BOX - A cast iron, stamped steel or nonmetallic box placed in the concrete floor (prior to pouring the concrete slab) of a building which is fed via conduit and used to house voice, data, power and video connections.

FULL DUPLEX - Simultaneous bi-directional signal transmission.

FURNITURE CLUSTER - A contiguous group of personal work areas, usually constructed from furniture, typically

including partitions of other space division, work surfaces, storage and seating. The work area cluster does not span aisles; all components are in contact or close proximity.

GSFIC - Georgia State Finance and Investment Commission

GTA – Georgia Technology Authority.

GHZ (GIGAHERTZ) - A unit of frequency equal to one billion Hertz (1,000,000,000 Cycles per Second).

GROUNDING CONDUCTOR - The conductor used to connect the grounding electrode to the building's main grounding busbar.

GROUNDING ELECTRODE - A conductor of a group of conductors (usually a rod, pipe or plate) in direct contact with the earth providing a low impedance connection to the earth.

HALF DUPLEX - A circuit which provides transmission alternately in either direction.

HEADROOM - The number of decibels by which a system exceeds the minimum defined requirements.

HERTZ (HZ) - A unit of frequency or bandwidth equal to one cycle per second.

HOME RUNS - A pathway or cable between two locations without a point of access in between. Characterized in Star Topologies.

HORIZONTAL CABLING - The cabling between and including the telecommunications outlet/connector and the horizontal cross connect.

HORIZONTAL CROSS CONNECT (HC) - A cross connect of horizontal cabling to other cabling, i.e., horizontal, backbone, equipment.

HUB - Connection point for circuits or a network. Hubs may be active or passive

HYBRID CABLE - An assembly of 2 or more cables of the same or different types or categories covered by one overall sheath.

IEEE - Institute of Electrical and Electronics Engineers.

IMPEDANCE - A unit of measure, expressed in Ohms, of the total opposition (resistance, capacitance and inductance) offered to the flow of an alternating current.

INFRASTRUCTURE, TELECOMMUNICATIONS - A collection of those telecommunications components, excluding equipment that together provides the basic support for the distribution of all information within a building or campus.

ISO - International Standards Organization. The body which promotes the development of worldwide standards.

INSERTION LOSS - The reduction in the amount of power received before and after the insertion of a component (i.e., connector, coupler or splice) into a previously continuous transmission line. Optical fiber insertion loss is referred to as 'power loss'.

INSULATION DISPLACEMENT - A type of wire terminal that requires no wire stripping; when the wire is correctly attached, its insulation is displaced (pierced) to form a connection. A popular form of insulation displacement termination is the 110 system.

INTERCONNECTION - A connection scheme that provides for the direct connection of a cable to another cable or to an equipment cable without a patch cord or jumper.

INTERMEDIATE CROSS CONNECT (IC) - A cross connect between first level and second level backbone cabling.

ISDN - Switched network providing end-to-end digital transparency transmitting voice and data over the same transmission facilities.

JACK - A receptacle used with a plug to make electrical connection between communication circuits. Jacks are considered the female component of a jack/plug connector. Jacks are typically used at the work area.

JACKET - The flexible covering of a cable, used to protect the color-coded conductors inside. Also referred to as a cable's "sheath".

JUMPER - An assembly of twisted pairs without connectors used to join telecommunications circuits/links at the cross connect.

LEC (LOCAL EXCHANGE CARRIER) - A private communications utility company or a government organization that furnishes services to the general public. It is typically licensed or regulated by a state or federal government agency.

LED (LIGHT EMITTING DIODE) - A semiconductor diode which emits light when a current is passed through it. In lightwave transmission systems, LEDs or lasers are used as light sources.

LINK - The link is regarded as the permanent portion of the cabling system. A test configuration for the link consists of up to 90m (295') of horizontal cabling, a telecommunications outlet/connector, and up to two cross connect connections in a telecommunications room. The link specifically excludes patch cords and equipment cords.

LOCAL AREA NETWORK (LAN) - A non-public data communications network confined to a limited geographic area used to provide communication between computers and peripherals.

LOOPBACK - A type of diagnostic test in which a transmitted signal is returned to the sending device after passing through a data communications link or network. This test allows the comparison of a returned signal with the transmitted signal.

LOSS - Reduction in signal strength, expressed in decibels (dB). Opposite of gain.

MAIN CROSS CONNECT (MC) - A cross connect for first level backbone cables, entrance cables, and equipment cables.

MHZ (MEGA HERTZ) - A unit of frequency equal to one million Hertz (1,000,000 Hertz).

METROPOLITAN AREA NETWORK (MAN) - An extended LAN operating within a metropolitan area and provides an integrated set of services for real-time data, voice and image transmission.

MICRON - A unit of length equal to one millionth of a meter (.000001 meter). Short for micrometer.

MIPS - Millions of instructions per second. A measure of processing power.

MODEM (MODULATOR DEMODULATOR) - A device which converts digital signals to analog signals (and vice-versa) for transmission over the telephone network, which usually is analog.

MT-RJ - A small form factor fiber connector that features a high-density design and RJ45 locking mechanism.

MULTIFIBER CABLE - An optical fiber cable containing two or more fibers, each providing a separate information channel.

MULTIMEDIA - A means of conveying information with components in different media such as voice, music, text,

graphics, image and video.

MULTIMODE OPTICAL FIBER - An optical fiber that will allow many bound modes to propagate. The fiber may be either a grade-index or step-index fiber. Typically used in premise environments only. Multimode Fiber cores are typically either 62.5 or 50 microns in diameter. See Single Mode Fiber.

MUTOA - A Multi-User Telecommunications Outlet Assembly, used to facilitate furniture rearrangement in open office areas. Defined by ANSI/ANSI/TIA/EIA 568B.

NANOSECOND (NS) - One billionth of a second.

NATIONAL ELECTRICAL CODE (NEC) - A nationally recognized safety standard for the design, construction, and maintenance of electrical circuits.

NETWORK - A formalized definition of the structure and protocols of a computer network.

NETWORK INTERFACE - The point of interconnection between telephone company communications facilities and terminal equipment, protective apparatus or wiring at a subscriber's premises.

NEXT (NEAR END CROSSTALK) - Electrical noise coupled from different wire pairs within a common sheath.

NODE - In general, any point of interconnection to a network where service is provided, used or communication channels are interconnected.

NOISE - Random electrical signals, introduced by circuit components or natural disturbances, which degrade the performance of a communication channel.

OPEN ARCHITECTURE - An architecture that is compatible with hardware and software from any of many vendors.

OPEN OFFICE - An office which a floor space division is provided by furniture, furniture partitions, or both instead of by building walls.

OPEN SYSYTEM INTERCONNECTION (OSI) - An internationally accepted framework of standards developed by the International Standards Association, for communication between two systems made by different vendors.

OPTICAL TIME-DOMAIN REFLECTOMETER (OTDR) - An instrument that characterizes cable loss by measuring the backscatter and reflecting of injected light as a function of time. It is most useful for locating splices, connections, and breaks. It is *not* as useful as a Fiber Optic Test Set for accurately measuring cable attenuation, and should therefore *not* be used to certify an optical link.

PASSIVE EQUIPMENT - Components and/or equipment that pass through an active signal.

PATCH CORD - A short length of copper wire or fiber optic cable with connectors on each end used to join communications circuits as a cross connect.

PATCH PANEL - A cross connect system of mateable connectors, utilizing patch cords, that facilitates administration.

PATHWAY - A facility for the placement of telecommunications cable.

PEDESTAL - A device usually mounted on the floor, which is used to house voice/data jacks or power outlets at the point of use.

PERSONAL COMPUTER (PC) - A computer for personal, single-user use, as opposed to main frames or minicomputers which are shared by many users.

PERMANENT LINK - The transmission path between two mated interfaces of cabling, excluding equipment cables, work area cables and cross-connections.

PHYSICAL LAYER - Within the OSI Model, the lowest level (Level 1) of network processing, below the link layer, concerned with the electrical, mechanical, and handshaking procedures over the interface that connects a device to a transmission medium.

PLENUM – In building construction, the space that is used for air circulation in heating and air conditioning systems, typically between the structural ceiling and the suspended ceiling or under a raised floor. The plenum space is often used to house the communication cables for the building's telecommunications network... In those instances, Plenum cable must be used.

PLENUM CABLE - Plenum cable is coated with a fire-retardant coating (usually Teflon) so that in case of a fire it does not give off toxic gasses and smoke as it burns. Required for use in plenum areas.

PLUG - The male component of a connection. Provides a method for connecting wires to a jack. It is typically used on one or both ends of equipment cords or on wiring for interconnects or cross connects.

POINT TO POINT TRANSMISSION - An uninterrupted connection between two pieces of equipment.

PORT - A functional unit of a node through which data can enter or leave a data network...

POWER METER – The most effective tool to measure light loss in a fiber optic link. Typically used to describe a test set used to accurately measure optical loss in a fiber optic link. Comprised of a light source, capable of injecting light at different frequencies into the fiber link; and the power meter itself, which when properly calibrated will display the amount of optical loss for that link.

POWER/COMMUNICATIONS POLE - A raceway placed between the ceiling and floor used in conjunction with a ceiling distribution system for the purpose of distributing communication and power service to a work area. Also called Utility Pole, Service Pole or Ceiling Drop Pole.

POWERSUM CROSSTALK - A measure of the combined crosstalk on a receive pair from all near end disturbers operating simultaneously.

PREMISES CABLING - The entire cabling system on the user's premises used for transmission of voice, data, video and power.

PRINTED CIRCUIT - A copper foil circuit formed on one or both faces of an insulating board to which circuit components are soldered. The copper foil pattern serves to connect components and is produced either by etching or plating.

PRIVATE BRANCH EXCHANGE (PBX) - A private telephone switching system, usually located on a customer's premises connecting a common group of lines from one or more central offices to provide service to a number of individual phones. Now used interchangeably with PABX (Private Automatic Branch Exchange).

PROPAGATION DELAY - The time it takes for a signal to travel from one point on a circuit to another.

PROTOCOL - A formal set of conventions governing the format and control of inputs and outputs between two communication devices or processes.

PVC - Polyvinyl Chloride. A type of plastic commonly used for cladding telecommunications cable.

PUBLIC SWITCHED NETWORK - Any common carrier network that provides circuit switching between public users, such as the public telephone network, telex or MCI's Execunet.

RACEWAY - Any channel designed for holding wires, cables or busbars such as conduit, surface raceways, cellular

floors or cable troughs.

RBOC (REGIONAL BELL OPERATING COMPANY) - One of the seven Bell operating companies that were formed during the divestiture of AT&T.

RCDD - The Registered Communications Distribution Designer is a professional status granted by BICSI based on knowledge of the telecommunications wiring industry.

REPEATER - In digital transmission, equipment that receives a pulse train, amplifies it, re-times it, and then reconstructs the signal for retransmission.

RETURN LOSS - The measure of the reflected energy caused by impedance mismatches in a cabling system.

RISER - The conduit or path between floors of a building into which telephone and other utility cables are placed to bring service from one floor to another.

RJ (REGISTERED JACK) - Registered Jack (RJ) wiring configurations developed by the Bell System for connection of customer premises equipment to the public network. Registered jacks serve telephone and data applications and are registered with the FCC. The most common types are: RJ45 and RJ11.

SC - Designation for an optical connector featuring a 2.5mm physically contacting ferrule with a push-pull mating design. This connector is recommended in the ANSI/TIA/EIA-568-A Standard for structured cabling.

SFF (SMALL FORM FACTOR) - A ANSI/TIA/EIA approved fiber adapter/connector system that provides two fiber strands in a surface area similar to UTP (RJ-style) connection.

SHIELD (SCREEN) - A metallic layer usually in the form of a braid or foil surrounding one or more electrical conductors to insulate them from electromagnetic interference.

SINGLEMODE OPTICAL FIBER - An optical fiber that will allow only one mode to propagate. This fiber is typically a step index fiber and typically has a core diameter of 8.3 microns.

SLEEVES - Short lengths of rigid metal pipe, approximately 4 in. (10.1 cm) in diameter, located in the telecommunications room (TR), which allow cables to pass from floor to floor when TRs are vertically aligned. Sleeves also provide for easy pulling of cable.

SLOTS - Openings in the floor of riser telecommunications closets that allow cables to pass thorough from floor to floor when closets are vertically aligned. A slot accommodates more cables than an individual sleeve.

SPLICE - The joining of two or more cables by connecting the conductors pair to pair. Not allowed with twisted pair cables per the 568B Standard.

ST - Designation for the “straight tip” connector developed by AT&T. This optical connector features a physically contacting non-rotating 2.5mm ferrule design and bayonet connector-to-adapter mating.

STAR - A physical point to point network topology.

STRUCTURED CABLING SYSTEM - A telecommunications cabling system, capable of supporting a wide range of applications. Generic cabling can be installed without prior knowledge of the required applications. Application-specific hardware is not a part of generic cabling.

SUBMINATURE D CONNECTOR - A family of multi-pin data connectors used in RS232-C communications. The connectors are available in 9, 15, 25 and 37 pin configurations. Sometimes referred to as DB9, DB15, DB25 and DB37 connectors respectively.

SURGE SUPPRESSION - The process by which transient voltage surges are prevented from reaching sensitive

electronic equipment.

SURFACE RACEWAY - A cable distribution method in which channels containing cables are run along or within the baseboards of a building.

SWITCHING - A function carried out by a switching hub, alleviating traffic by making virtual connections between transmitting and receiving nodes.

T1 - A digital transmission link with 1.544 Mbps bandwidth. T1 operates on two twisted pairs and can handle 24 voice conversations, each digitized at 64 Kbps. More voice channels are available with advanced digital voice encoding techniques.

T1 CARRIER - The AT&T digital transmission system which transmits data at 1.544 Mbps (See also T1).

TELECOMMUNICATIONS - For the purposes of this Glossary, a term encompassing voice, audio/visual, and data communications in the form of coded signals transmitted over media.

TELECOMMUNICATIONS OUTLET - A device where the horizontal cable terminates in the Work Area (WA). The telecommunications outlet provides the interface to the work area cabling.

TELECOMMUNICATIONS ROOM (TR) - A Telecommunication Room is an enclosed space for housing telecommunications equipment, cable terminations and cross-connect cabling. Typically, this room is used as the location of the horizontal cross-connect and serves a floor.

TELECOMMUNICATIONS ENTRANCE - The point where telecommunications lines enter or leave the building.

TERMINATION - The act of attaching connectors to bare cabling. In the case of data cabling, terminations must be in accordance with standard wiring codes and standards.

TOPOLOGY - The geometric description of the physical or logical connections of a telecommunications system. Typically described as bus, ring or star.

TRANSCEIVER - A single device capable of both sending and receiving information.

TRANSIENT - An abrupt change in voltage, of short duration, which may cause signal impairments, loss of memory or physical damage to equipment.

TRANSMISSION MEDIA - Anything such as wire, coaxial cable, fiber optics, air or vacuum, that is used to carry an electrical signal.

TRUNK - A specialized communications path between two points, one of them usually being a telephone company central office or switching center.

TWISTED PAIR CABLE - A type of communication transmission cable in which two individually insulated wires are twisted around each other to reduce induction (thus interference) from one wire to the other. The pair may be surrounded by a shield, insulating jacket or additional pairs of wires.

USOC - Universal Service Ordering Codes (USOC) are a series of Registered Jack (RJ) wiring configurations developed by the Bell System for connection of customer premises equipment to the public network.

UTP – Unshielded twisted pair copper cable.

WAVELENGTH - The length of an electromagnetic waveform as measured from any point on one wave to the corresponding point on an adjacent wave, such as from crest to crest. Wavelength is inversely proportional to frequency.

WIDE AREA NETWORK (WAN) - A communications network designed to serve hundreds or thousands of miles using common carrier-provided lines, such as the nationwide telephone network. Compare with LAN.

WIDEBAND - A communications channel or medium having a bandwidth sufficient to carry multiple voice/video or data signals simultaneously.

WORK AREA / WORK STATION (WA) - A building space where the occupants interact with telecommunications equipment.

APPENDIX B - REFERENCES

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Occupational Safety and Health Administration (OSHA) – Worker Safety

National Electric Code (NEC) – Intrabuilding electrical safety

National Electric Safety Code (NESC) - Interbuilding electrical safety

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American National Standards Institute (ANSI) - Standards

American Insurance Association (AIA)- Insurance standards for buildings and infrastructure

Insulated Cable Engineers Association (ICEA) - Manufacturer's organization that writes specifications for cable

Building officials and Code Administration (BOCA) - Building Codes

National Fire Protection Association (NFPA) - Fire safety codes

National Institute of Standards and Technology (NIST) - Technology Standards

ATM Forum - Standards body for ATM standards

International Organization for Standards (ISO) - Produces standards documents

Institute of Electrical and Electronics Engineers (IEEE) - Electronics, Telecom, and Electrical standards

Federal Communications Commission (FCC)

The Americans Disabilities Act (ADA) - Federal Regulation

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AT&T Plant Standards - Outside/Entrance Plant

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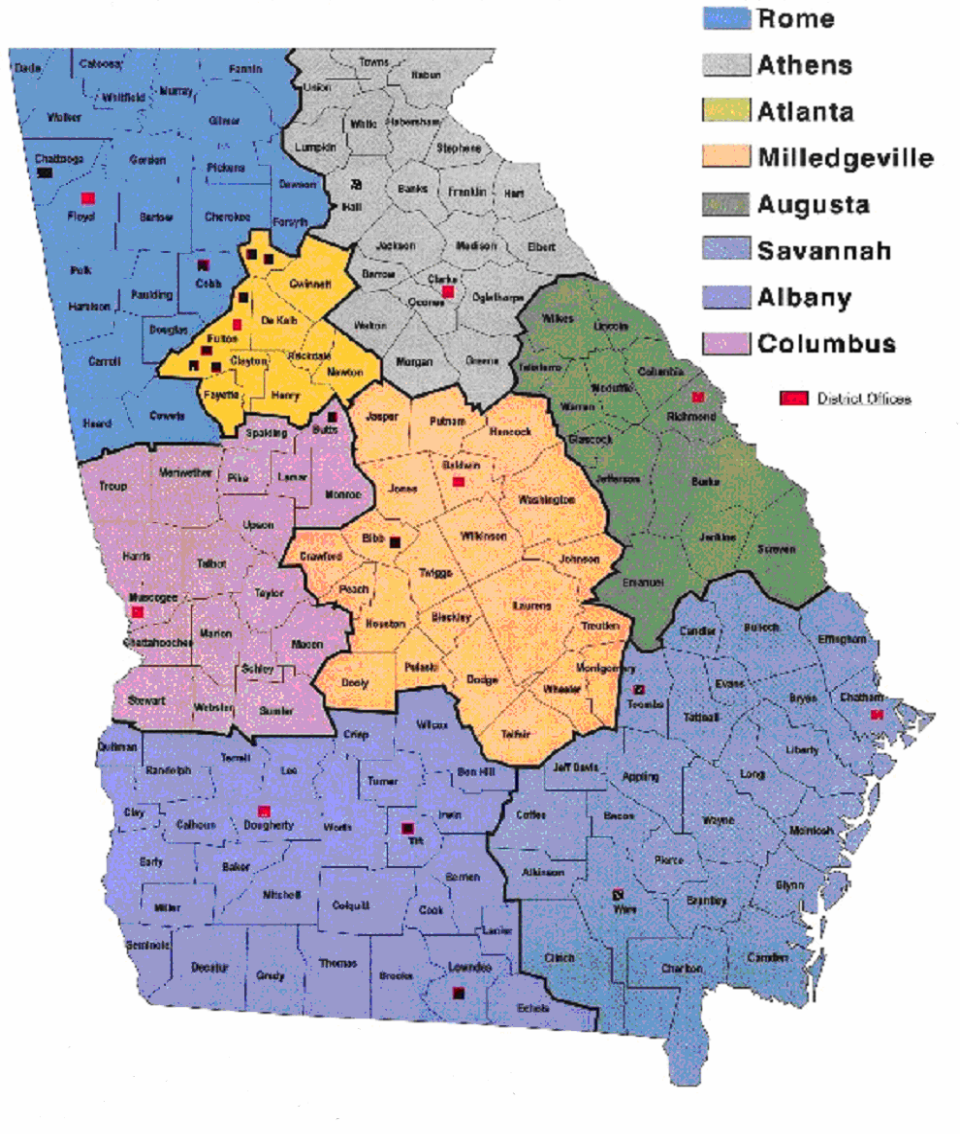
APPENDIX C – GTA/RCDD CONTACT INFORMATION

GTA District Offices



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